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LOGISTIC SUPPORT IN THE VIETNAM ERA

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MONOGRAPH 7

CONTAINERIZATION

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A REPORT
BY THE JOINT LOGISTICS REVIEW BOARD

464



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

18 DEC 1970

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INSTALLATIONS AND LOGISTICS

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CHAPTER I
INTRODUCTION

CHAPTER I

INTRODUCTION

1. BASIS FOR STUDY. In its Terms of Reference, the Joint Logistics Review Board was directed to give particular attention to transportation, including containerization. The impact of containerization extends beyond transportation into many other areas of logistics. In view of this and potential benefits in these areas, the Board decided to treat containerization as a separate subject.

2. SIGNIFICANCE OF CONTAINERIZATION. Since 1966 U.S. industry has invested several billion dollars in container facilities, equipment, and containerships. As a result of a tremendous growth in the use of containers for cargo movements, shippers, consignees, port authorities, transportation carriers, distribution equipment manufacturers, insurers, transportation regulatory agencies, customs authorities, and laborers are all making adjustments in their services, equipment, and regulations to accommodate this unit load principle. The overwhelming advantages of containerization versus breakbulk commercial operations led to the conclusion that there will be less and less commercial breakbulk sealift capability available and that eventually the military must rely on containership support for the bulk of overseas movement of cargo. Recognizing this, the Department of Defense (DOD) objective of containerization of ocean cargo is "to insure the maximum use of containerization in the overseas shipment of ocean cargo to the extent that this method of shipment is cost favorable to the Department of Defense as a whole as compared with breakbulk methods (loading of individual boxes on vessels)."¹ Further, the DOD long-range master plan for logistics systems developments, LOGPLAN 70, highlights as objective number one that: "Direct delivery concepts and systems, to include the need for high speed direct support from supplier to customer, and the expansion of containerization techniques."² To further the achievement of this objective, specific containerization goals have been established in coordination with each Service. Full exploitation of containerization provides for the application of mass production techniques to the flow of materiel through the distribution system by breaking military cargoes into standard units to facilitate standardized handling operations mode-to-mode and through each staging area in the distribution system.

3. STUDY OBJECTIVES. The objectives of this monograph are to examine and evaluate the use of containerization to support U.S. forces during the Vietnam era; to examine trends for the future, to determine the effects of containerization on the distribution system, equipment, facilities, manpower, and responsiveness, and to make appropriate recommendations for improving the efficiency and effectiveness of military logistics through the use of containers to support both peacetime and military contingency operations.

4. SCOPE OF STUDY. This monograph is focused on experience gained through the use of containers for moving military cargo during the Vietnam era and the potential of containerization to improve the responsiveness, effectiveness, and economy of future military logistic support operations.

¹Department of Defense, Status Report, Logistics Performance Measurement and Evaluation System, 30 September 1969, p 31

²Minutes of the Meeting of the DOD Logistics Systems Policy Council, 14 March 1970.

CONTAINERIZATION

5. ORGANIZATION

a. This monograph contains three additional chapters:

(1) Chapter II contains a description of the use of containers and its economic implications.

(2) Chapter III contains a discussion of developing container-oriented logistic systems for use within DOD. The chapter includes a discussion of the supply distribution considerations, equipment and transportation resources necessary to handle and transport intermodal containers, depot and terminal requirements, containerships, equipment standardization, and the use of containers in logistics-over-the-shore operations.

(3) Chapter IV contains a summary of the major issues and significant conclusions and recommendations.

b. To assist the Joint Logistics Review Board in the review of containerization, the Department of the Army contracted with the American Power Jet Company, Ridgefield, New Jersey, for an analysis of the experiences gained by the Services in using containers during the Vietnam era. This report is attached as Appendix A. The Board gave general endorsement to the overall thrust of the report, as well as the advantages and problems highlighted in the report findings; however, the Board did not verify all data and the analysis contained in the report.

CHAPTER II
USE OF CONTAINERS AND ITS ECONOMIC IMPLICATIONS

CHAPTER II

USE OF CONTAINERS AND ITS ECONOMIC IMPLICATIONS

1. GENERAL

a. The military potential and economic implications of containerization demonstrated by the Vietnam experiences are summarized in this chapter.

b. Many new terms are involved in the field of containerization. The following list defines general container terms used in this monograph. In addition, where appropriate, illustrations are used throughout the text to show some of the container equipment either now being used or planned for in the future.

(1) Unitization — The assembly, into a single load, of more than one package of one or more different line items of supply in such a manner that the load can be moved in an unbroken state from source to distribution point or user as far forward in the supply system as practical.

(2) Containerization — The use of containers to unitize cargo for transportation, supply, and storage. Containerization incorporates supply, security, packaging, documentation, storage and transportation into a distribution system from source to user.

(3) Stuffing — An industry-accepted term meaning the placing of the material into a container.

(4) Intermodal Transport — This term is normally used to describe the capability of interchange of modular van-container units among the various carriers. In spite of the fact that intermodal containers are of different standard sizes they have common handling characteristics, which permits them to be readily transferred from truck to railroad to ocean carrier, as necessary.

(5) Breakbulk Cargo — Cargo (including outsized) that consists of many units or unitized packages of general cargo requiring a considerable amount of movement and handling for each loading and unloading and for each change in transportation mode.

(6) 463L System — A materials handling system, developed by the United States Air Force (USAF) in the early 1960's to efficiently unitize, load, unload, and move air cargo in both USAF and commercial cargo aircraft.

(7) Container — An enclosed, permanent, reusable, nondisposable, weather-tight shipping conveyance, fitted with at least one door and capable of being handled and transported by existing equipment and modes of land, air and sea transport. (See Figure 1.)

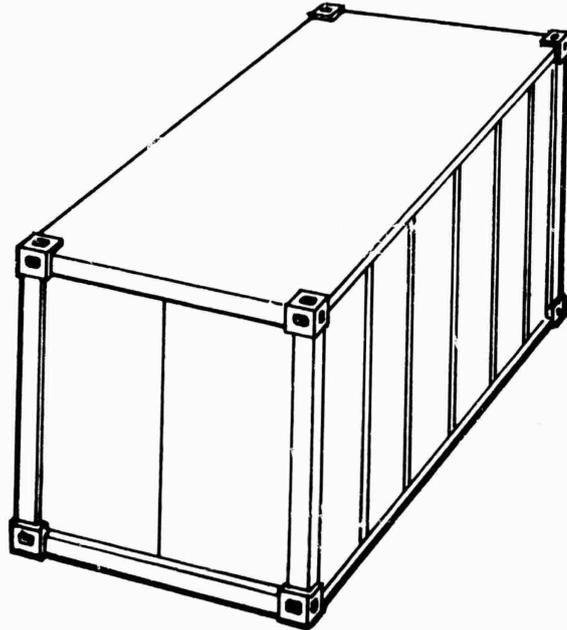


FIGURE 1. CONTAINER

(8) Van-Container/Sea Van-Container — A standard container of a size similar to a highway trailer so designed that it can be transported on carrier equipment including ships. The standard dimensions for van-containers designated by the International Standards Organization for use in international traffic are 8 feet wide, 8 feet high, and lengths of 10, 20, 30, and 40 feet.

(9) Intermodal Container — A van-container designed to facilitate its transfer from one mode of transportation to another without unloading and reloading the contents.

(10) Stowable Container — A rigid or collapsible, reusable or expendable, container that can be stowed in a standard van-container or carrier equipment. It is used as an inner container or consolidation unit.

2. COMMERCIAL TRENDS

a. Although containers had been used in breakbulk shipping by the U.S. Army as early as 1953, there was little commercial interest in the use of large shipping containers until 1956. This early interest was in intracoastal trade between New York and Houston, between the U.S. west coast and Hawaii and between the U.S. east coast and gulf coast and Puerto Rico. In 1965, a U.S. company announced its intention to enter scheduled containership service in the North Atlantic. American companies have led the container revolution and foreign ship owners have been forced to follow suit. Container service was expanded and extended to other areas of the world. As of 30 June 1969, there were 79 U.S. flag containerships and an additional 103 U.S. flag ships with partial capacity for containers.

b. The development of the containership fleet has been accompanied by a reduction in the U.S. flag breakbulk cargo fleet. During 1970, approximately 460 breakbulk ships and 120 containerships will be in the U.S. merchant marine. By 1980, the estimated number of breakbulk ships will be reduced to approximately 190, whereas containerships will increase to around 220. Total sealift capability in 1980 will be about the same as in 1970 because fewer but much more productive ships will be available.¹

¹Office of the Secretary of Defense (Systems Analysis), Military Container Operations, 10 December 1969.

CONTAINERIZATION

c. The Military Sea Transportation Service (MSTS) has projected that the availability of breakbulk dry cargo ships would be insufficient subsequent to 1972 to meet Department of Defense requirements during emergency periods.²

d. The domestic transportation industry is also involved in this move toward containerization, and there are significant strides in the use of intermodal containers to offer shippers a through service that utilizes both truck and rail.

e. With the introduction of large "jumbo" transport aircraft, intermodal container movements utilizing both air and surface modes of transportation are foreseen. Industry trends indicate that 80 percent of all commercial air freight will be moved by containers in the near future. It is logical to expect that if containers are cost effective in commercial air freight, they will probably prove so in military operations.

3. MILITARY CARGO UNITIZATION AND CONSOLIDATION. During the Vietnam buildup, the off-loading of breakbulk cargo from ships was difficult due to insufficient deep water berths and inadequate cargo handling equipment and facilities. These problems were further complicated by the poor packaging of cargoes. Cartons deteriorated in the heavy rains; light cans of asphalt burst in the hot weather and in handling; and loose items were difficult to off load. These difficulties delayed ship discharge, thereby contributing to port congestion and slow ship turn around. In addition, ship delays were increased by the practice of loading ships for a number of different destinations. Several actions were taken to relieve port congestion and ship discharge problems. These included a program established by the Army for all-weather packaging, unitization, palletization, and block stowage of cargo, and the Military Traffic Management and Terminal Service (MTMTS) was requested to load ships for single port discharge. The Commander, Service Force, Pacific Fleet (COMSERVPAC), also instituted a program for all-weather packaging, heavy duty strapping, and palletization of all cargo destined for Da Nang and Chu Lai. In addition, COMSERVPAC requested the Commander, Western Sea Frontier, to place an embargo on any cargo destined for undeveloped ports in the I Corps Tactical Zone (CTZ) area that had not been unitized and consolidated. These combined actions by the Services coupled with other related steps served to ease the water port congestion, speeded up ship turn around, and clearly demonstrated the benefits derived from unitization and consolidation of cargo. The U.S. Air Force recognized that the advantages of unitization and palletization of loose pieces of cargo would reduce cargo handling needs, improve aircraft turn around time, reduce manpower requirements, save distribution costs, and reduce aircraft ground time exposure in-country. For this reason the 463L air cargo handling system was used extensively by the Air Force in supporting air movements to and within the Republic of Vietnam (RVN).

4. USE OF SMALL CONTAINERS

a. CONEX. At the start of the Vietnam era, the role of containerization was limited primarily to the use of CONEX containers, the first major effort to apply containerization on a large scale (Figure 2). Although 96,000 CONEX containers were available to the Army and Air Force in 1965, it was necessary to procure additional containers. The CONEX inventory was increased to over 200,000 by 1967 and most of these CONEX containers were shipped to Vietnam and were retained there for logistic uses. Perhaps their most valuable use was as storage facilities in locations where such facilities neither existed nor were planned.

² MSTS, Presentation for the Joint Logistics Review Board, 19 June 1969.

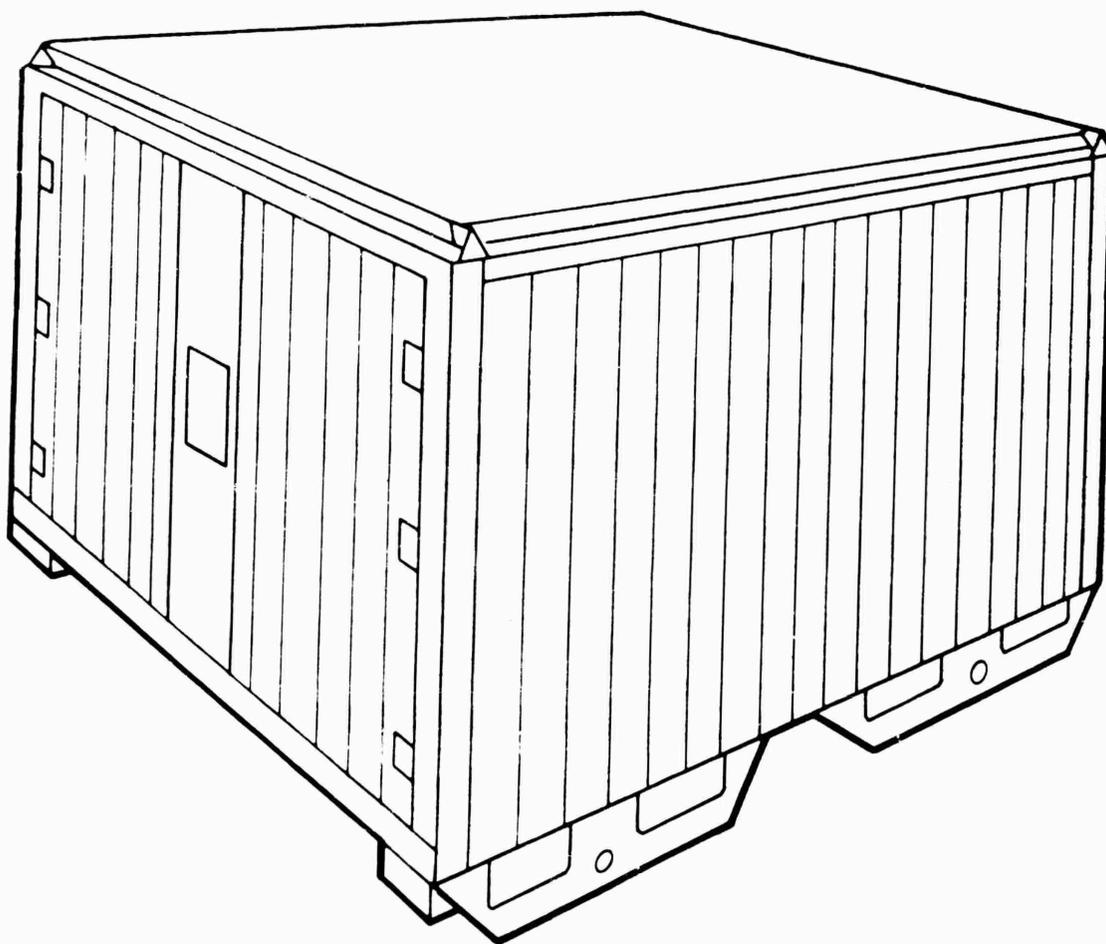


FIGURE 2. CONEX II CONTAINER

(The dimensions of the CONEX II are 75 by 82 1/2 by 102 in. The CONEX container is a metal reusable shipping box. The most common type has a 295-cu. ft. capacity, is about 8 1/2 by 6 by 7 ft., and can carry 9,000 lbs. The dimensions of the half-CONEX or CONEX I container are 75 by 82 1/4 by 51 in.)

CONTAINERIZATION

(1) Unit Deployment — The CONEX container was used extensively during the buildup phase to containerize accompanying unit equipment and supplies. During the period from 1966 through 1968, a total of 21,039 CONEX containers were used in connection with unit deployments.³ The number would have been greater if more of these containers had been available. Use of these containers facilitated the rapid movement of unit equipment into Vietnam by reducing loss, damage, and pilferage and by reducing handling requirements. They also provided interim storage for the unit equipment and support of redeployments in-country.

(2) Movement of Cargo — Between 1966 and 1968, 156,287 CONEX containers were shipped to Vietnam, carrying approximately 938,000 measurement tons (MTONS) of cargo.⁴ Once packed at the CONUS supply point, consolidation point, or terminal, the container was handled throughout the distribution system as one entity and moved as far forward as desired without rehandling of the contents. This experience with the use of the CONEX for movement of resupply cargo to forces overseas proved that containerization expedited the flow and increased the security of the cargo.

(3) Storage — Of the 156,287 CONEX containers shipped to Vietnam nearly all were retained in-country and were used for temporary storage and other mobile facilities. These CONEX containers provided, approximately 6 million square feet of temporary covered storage space,⁵ whereas other covered storage available to the U.S. Army in Vietnam as of 28 February 1969 was 5,370,000 square feet.⁶ This use of the CONEX provided rapid response to contingency storage requirements and produced savings by reducing loss and damage to supplies and permitting better stock location and control.

b. Mount-Out Boxes. The Marine Corps utilizes predominantly two types and dimensions of wood mount-out boxes. One type is designed to be handled manually and weighs about 38 pounds, with interior dimensions of 37 in. by 10 in. by 14 1/2 in. The second type is a box pallet 32 in. by 40 in., with interior dimensions of 30 in. by 27 in. by 29 in. The first type of box can be loaded 6 to a 30-in. by 42-in. pallet during transit, and it and the box pallet can be handled with mechanical handling equipment. The quantities of these mount-out boxes required for the deployment of a type infantry battalion are 1,000 boxes, 100 box pallets, and 200 boxes of miscellaneous sizes. The precise quantity mix of mount-out boxes varies among infantry battalions as well as other units based on the varieties of the types and quantities of mount-out supplies authorized to support specific deployments. Experience with this method of containerization during the Vietnam era has confirmed that it was a logistic system strength and a major factor in the speed with which the Marines were able to deploy and establish support in-theater.

c. War Readiness Spare Kits. The Air Force's War Readiness Spare Kits (WRSK) provided another example of using containerization for the movement of material and support of overseas supply operations. All Air Force tactical units deploying to SE Asia were provided with War Readiness Spare Kits. These kits were air transportable and consisted of a 30-day supply of repair parts at wartime rates for the particular weapons system. Units operated out of these kits and requisitioned replacement parts to maintain the kit level. Experience with the WRSK program in Vietnam confirmed this concept as a logistic system strength and permitted the Air Force to rapidly deploy their units with immediate supply support in-theater.

5. MOVEMENT AND STORAGE OF BINNED SUPPLIES. One of the most successful uses of containers in Vietnam was their application to the movement and storage of binned supplies.

³ Hq., USAMC, Letter, to JLRB, subject: CONEX and Packaging Information Request, 18 November 1969, TAB A.

⁴ Ibid.

⁵ USAMC, Briefing, to JLRB, August 1969.

⁶ Military Construction Status Report, South Vietnam — Base and Country Summary — RCS: DD I&L (M) 915 as of 28 February 1969.

CONTAINERIZATION

a. Binned Container Support of Units. Early in the Vietnam era, the U.S. Army Aviation System Command used its demand data files to calculate the small repair parts requirements for the support of aviation units in the field. The Sharpe Army Depot installed wooden bins inside CONEX containers, filled these bins with parts, inserted the necessary blocking and bracing, and inclosed in each CONEX a set of punch cards identifying each line item by stock number, quantity, and specific location within the container. On arrival at the support unit in Vietnam, the punch cards were inserted in the stock record files of the unit. Thus, it was not necessary to handle these parts from the time they were placed in the bin at Sharpe Army Depot until they were actually issued for use in Vietnam. Later, this concept was expanded to include other types of repair parts. From August 1965 through August 1968, a total of approximately 6,000 prebinned CONEX containers were shipped to Vietnam.

b. Push Package. During 1965 and the early part of 1966, the construction of depot facilities at Cam Ranh Bay seriously lagged behind the increased flow of supplies and equipment to the depot. This imbalance in capability caused an ever increasing backlog of supplies in the depot receiving areas requiring processing for storage. As a result the Army Materiel Command established a push package, Project YZJ, to help increase the supply effectiveness of the Cam Ranh Bay Depot. Early in 1966, the Army computed a 60-day stockage level of repair parts for all units to be supported by the Cam Ranh Bay depot as of the end of June 1966. The strength of these units was then estimated at about 95,000. Equipment density data for this force were computed by the Major Items Data Agency (MIDA), and the National Inventory Control Point (NICP) used these data and established replacement factors to compute the repair parts required. Unlike previous shipments, the items involved were consolidated at assembly depots (Sacramento and Tooele Army Depots), where teams assembled the items into an actual depot operation. The initial estimate was that the total package would consist of 70 military van semitrailers and 500 CONEX containers stocked with a total of approximately 98,000 line items. The containers were equipped with shelves designed for flexibility in order that large as well as very small items could be easily and accessibly stored in fiberboard box part containers compatible with the shelf design. When completed, the entire package with approximately 53,000 line items was binned in 70 military van semitrailers and 437 CONEX containers, and a library of manuals, stock record, locator cards, and other documentation was assembled to accompany them. This concept represented container-oriented logistics in a sophisticated form: a section of the depot moved intact from the United States to Vietnam and was a good example of the integration of supply and transportation systems. The Project YZJ packages arrived at Cam Ranh Bay on 21 May 1966. The success of this operation is indicated by the fact that there were only 26 warehouse denials (less than 0.2 percent) during the first 10 days out of a total of 13,538 material release orders issued. The lessons learned from project YZJ should be considered for application in future push packages as well as for configuration of pre-positioned war reserve stocks.

6. INTERMODAL CONTAINER SERVICE

a. The military use of containerships and the larger sea van type of intermodal container was very limited at the beginning of the Vietnam era. All shipments to continental United States (CONUS) terminals were shipped breakbulk. Cargo was containerized within the port commercial zone and then shipped by a captive commercial carrier on well-established trade routes. The principal route was from the port commercial zone of west coast CONUS terminals to Hawaii, with a very small amount from the port commercial zone of east coast CONUS terminals to Europe.

b. The first contract containership service (west coast CONUS terminals to Okinawa in 1966) was also the initial step in permitting the shipper to containerize cargo at a depot for shipment to overseas destinations. The establishment of this container service created a requirement for consolidation and distribution points, some of which were outside the port commercial zone.

CONTAINERIZATION

c. The extension of the Okinawa contract in April 1967 to include Subic Bay, Philippine Islands, and the initiation of a contract service from west coast CONUS terminals to Vietnam substantially increased container service in the Pacific. Under contract to the Military Sea Transportation Service, Sea Land Services, Inc., initiated container service to Da Nang on 10 July 1967 and to Cam Ranh Bay on 18 October 1967.

d. Service to Da Nang was provided by self-sustaining containerships. This method was selected primarily to expedite the commencement of the service and to eliminate any delays that might be encountered in the installation of shore based crane operations. Preparatory requirements at Da Nang in addition to the deep-water berth, were for chassis, tractors, and marshalling areas. Three C2 self-sustaining containerships, with a capacity for 226 containers 8 by 8.5 by 35 ft., were used in the circuit from Long Beach to San Francisco to Da Nang to Long Beach. A containership was scheduled to arrive in Da Nang each 15 days, with an average load of 9,000 MTONS.⁷

e. The Cam Ranh Bay service was provided with three C4-J nonself-sustaining containerships, each having a capacity of 662 35-foot containers. To provide the required service to Saigon and Qui Nhon, one self-sustaining C2 was used as a shuttle from Cam Ranh Bay. Leaving San Francisco, the C4-Js had a scheduled arrival each 15 days at Cam Ranh Bay, with approximately 24,000 MTONS per vessel. The return route was to San Francisco by way of Seattle.⁸

f. The container service contractor provided enough tractors, containers, and chassis at the port areas in Vietnam and the United States to sustain the operation. The contractor was also required to:

- (1) Unload inland transportation equipment and load the container in the United States.
- (2) Spot empty containers in metropolitan areas.
- (3) Repair and maintain his own equipment.
- (4) Receive less than container load lots (LCL) shipments and consolidate to produce full container loads.
- (5) Provide transportation to inland destinations within 30 miles of the port of discharge in Vietnam.⁹

g. The Government was required to do the following:

- (1) Give priority to containerships for tugs, pilots, and berthing overseas.
- (2) Provide the contractor with 1 acre of land at each port for contractor buildings overseas.
- (3) Provide hardstands for marshalling areas with sufficient electrical outlets for reefer containers at Cam Ranh Bay, Saigon, Da Nang, and Qui Nhon.
- (4) Return dry cargo containers within 30 days, and reefer containers within 45 days, or pay demurrage at specified rates.
- (5) Reimburse the contractor for lost, damaged, or stolen equipment.

⁷ American Power Jet Co., Report 589-5, Containerization Based on Lessons of the Vietnam Era, Ridgefield, New Jersey, January 1970.

⁸ *Ibid.*, p. 2-26.

⁹ Sea Land Services, Inc., Contract No. 00337 SA1029, 29 March 1969.

CONTAINERIZATION

(6) Pay a container rental fee to the contractor when moving a container in the United States with commercial carrier.¹⁰

7. **DIRECT SHIPMENTS TO FORWARD AREAS.** The shipment of large quantities of single or like commodities from CONUS to forward locations in RVN proved to be feasible, desirable, cost effective, and responsive to the customers' needs.

a. Shipments of multi-fuel engines consisting of 13 engines per container, with approximately 40 containers per ship sailing every 15 days permitted direct delivery to the using unit and permitted an even flow of material. Similar shipments of helicopter blades, modification kits, sand bags, and reefer products were made with the same efficiency and effectiveness. These shipments permitted expeditious movement from origin to destination with corresponding reduction in double handling at each node in the transportation and supply systems, and they gave the using units a degree of confidence of timely delivery never before experienced with breakbulk shipments.

b. During December 1969 and January 1970 the military made a test shipment of ammunition in containers to Vietnam. The operation was titled Test of Containerized Shipments of Ammunition (TOCSA).¹¹ This test used commercial containers to move ammunition directly from ammunition depots in CONUS to depots and forward ammunition supply points in Vietnam. This test is well documented because of the detailed planning and direct supervision of all aspects. Some of the more significant advantages to the military were as follows.¹²

(1) The large increase in the port capability is particularly important for ammunition shipments, since CONUS active terminals are limited to four, two on the east coast and two on the west coast. Overseas ammunition port capability is an important factor in eliminating or reducing the delay of ships to a minimum.

(2) The safety of the terminals and the ship while in port was greatly enhanced because of the reduction of time that ammunition was in the terminal for loading, the reduced overall length of time the ship was required to be in port, and the rapid dispersion of the ammunition after it was discharged from the ship.

(3) The security of the cargo was improved to a large degree by sealing the containers at origin and, except for opening the containers for inspection purposes during the test, the containers remained sealed until delivered at final destination.

(4) Double handling was reduced 2 to 8 times compared to breakbulk shipments depending on the origin and destination of the containers. As a result, the cargo was received in better condition at destination.

(5) In-transit time from origin to final overseas destination was reduced to only 40 days for project TOCSA, as compared to about 60 days for breakbulk shipments originating on the west coast.

(6) One of the most important benefits to the military was highlighted by the report on project TOCSA by the 1st Logistical Command. The command stated that if containerized ammunition shipments were regularly scheduled to Cam Ranh Bay, it would be possible to phase out the Qui Nhon ammunition supply depot where substantial losses through enemy action had occurred. Other advantages will develop when shipments are made on a routine rather than a test basis.

¹⁰ ibid.

¹¹ Hq., USAMC, Project TOCSA, Test of Containerized Shipments of Ammunition, December 1969.

¹² Hq., USAMC, Report of Project TOCSA, 20 April 1970.

CONTAINERIZATION

c. The Deputy Assistant Secretary of the Army has directed that a total system technique be developed and instituted as early as possible for containerized shipment of ammunition from CONUS sources to overseas consumption points. The system will include special rates for rail and highway movement of containerized ammunition provided by MTMTS and specific rates for ocean movement provided by MSTs for self-sustaining containerships between CONUS east and west coast terminals to Vietnam. It was also directed that further action be taken with the U.S. Coast Guard to increase the present weight limitation and to take advantage of the technological improvements made in dunnage and tie down equipment.¹³

d. It is incumbent on the Services to expand the list of commodities to make similar shipments in order to maximize the potential available through containerization and delivery to forward echelons. The list should include but not be limited to such items as all reefer products, tires, batteries, paper products, clothing, rations, packaged petroleum products, electronic equipment and large volume repair parts.

8. **IN-TRANSIT LOSS AND DAMAGE.** The reduction in in-transit loss and damage through the use of containerization has been acknowledged by the Services. Outstanding results have been obtained by containerizing items as shown below.

a. Shipments to Subic Bay via containerships resulted in damage being reduced from over \$100 per private owned vehicle (POV) shipped to less than \$10 per POV shipped via the container mode. Damage and pilferage to other commodities were substantially reduced as containership operations reflected a near perfect receipt of general cargo. Reefer cargo loss is negligible via container compared to an average 10 to 15 percent loss via conventional mode.¹⁴

b. Fifteen percent of the value of Post Exchange goods shipped to Vietnam was pilfered under breakbulk shipments; almost none was pilfered under Sea Land shipments.¹⁵

c. Breakage has been reduced by 50 percent through containerization. In 1965, Matson's claim ratio (percent of claim payments to revenue) was 3.21 percent for non-containerized cargo and 1.16 percent for containerized cargo. In 1966, the ratio was 2.51 percent for breakbulk cargo and 1.04 percent for containerized cargo.¹⁶

d. Claims were reduced from \$.43 per ton to \$.06 per ton for containerized shipments from the United Kingdom to Australia, and on shipments from Australia to the United Kingdom claims were reduced from \$.60 to \$.06 per ton.¹⁷

e. Project TOCSA provided another outstanding example. Not a single round of ammunition was lost or damaged from CONUS origin points to forward locations in Vietnam. Shipments were made from 4 CONUS inland ammunition plants and the Sierra Army Depot to as far forward as Pleiku, An Khe, Ban Me Thout, and landing zone English. Ammunition consisted of 8-in., 155 and 175 millimeter propellant charges and projectiles, 105 high explosives (HE), 2.75-in. rockets, and small arms.¹⁸

¹³ Assistant Secretary of the Army, Memorandum, to Deputy Chief of Staff for Logistics, subject: Report of the Test of Containerized Shipment for Ammunition, 12 May 1970.

¹⁴ Commander, Service Force, U.S. Pacific Fleet, Weekly Summary of Command History, 3 December - 9 December 1967.

¹⁵ Maj. Richard E. Stephenson, The Containerization Revolution - Its Military Impact, April 1968.

¹⁶ Traffic World, "Containers Great, But Good Cargo Packing Is Needed," 30 March 1968, pp. 54-57.

¹⁷ Container News, "Carrier Reports 92 percent Drop in Claims," November 1969, pp. 18 and 34.

¹⁸ Hq., USAMC, Report of Project TOCSA, 20 April 1970.

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9. SUBIC BAY OPERATIONS. Containerization resulted in many advantages for shipment of cargo from CONUS to other areas and is typified by container shipment to Subic Bay, Philippine Islands, as follows:¹⁹

- a. Reduction of inventory levels and investments by Naval Supply Depot and Navy Exchange, Subic Bay, due to dependable regularly scheduled sealift of containerized cargo.
- b. Stevedoring effort in ship discharge operations was reduced.
- c. Less overall cost to Government, per measurement ton savings estimated at \$13.57 by utilization of containers for general cargo shipments. (This was based on self-sustaining containerships. Where nonself-sustaining containerships could be utilized, the cost differential was greater.)
- d. In-transit time for cargo shipped by breakbulk was reduced from 40 to 45 days to 21 days by containership, with an 11-day sailing frequency from CONUS port.
- e. Containers provided a secure and covered transit storage for cargo at destination.
- f. Materials handling equipment (MHE) requirements were reduced.
- g. Decreased cargo procurement costs, i. e., beer and beverage vendors cut prices up to 10 cents per case if authorized to stuff in container load lots at their plants.
- h. Chill and freeze cargo were received in excellent condition via container at an estimated savings of \$13.00 per MTON. Reefer products were shipped at an optimum individual temperature in containers vice one average temperature for all products shipped by conventional mode.
- i. Favorable retrograde rates permitted reduced handling and carriage costs and reduced the requirement for overpack necessary for conventional shipments. Retrograde ammunition components shipped by container resulted in reduced time and costs of handling. Service personnel could be given actual date of loading and arrival of their household goods and automobiles in CONUS to facilitate their personal planning.

10. PORT FACILITIES IMPACT. Containerization contributes to a major increase in port throughput capacity because of the faster ship recycling time of 48 hours, as compared to the 10-14 days required to recycle a breakbulk ship with retrograde cargo. Thus the efficiency of containerization offers an opportunity to reduce the number of deep-draft berths that would be required for breakbulk operations.

11. IMPACT ON AMMUNITION OUTLOADING PORT FACILITIES. A study²⁰ has been made to determine how the potential advantages of containerization can be realized at the Naval Weapons Station, Concord, the main ammunition outloading facility on the west coast of the United States, and what new facilities would be required to support container operations. The study indicates that in the case of an interim plan to accommodate self-sustaining containerships a capital investment of \$425,000 for the construction of additional storage and staging areas and a truck control gate could have been amortized in 14 days under the level of outloading effort in FY 68. In the case of a mid-term plan for support of nonself-sustaining containership, a capital investment of \$5,967,000 for extensive pier modification, dredging, construction of container repair and fumigation facilities plus the storage areas to support the interim plan could have been amortized in about 6 months. It was further indicated that the potential for

¹⁹ Commander, Service Force, U.S. Pacific Fleet, Weekly Summary of Command History, 3 December - 9 December 1967

²⁰ Naval Weapons Station, Concord Letter, Ser 0185, 9 September 1969.

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improving explosive safety would far exceed the economic advantages, that the number of men working on the waterfront would be reduced by 90 percent, and that the number of separate operations would be reduced greatly.

12. SHIP REQUIREMENT IMPACT. Ten trans-Pacific containerships, such as those used in providing service to Vietnam in 1969 from the west coast, have the capacity to move 1.6 million measurement tons of cargo per year. An equivalent 48 Victory ships (breakbulk) would be required to lift this amount of cargo. When considering the fact that 10 containerships can provide the equivalent trans-Pacific service of 48 Victory ships, it is obvious that substantially fewer ships would have been required to move cargo to Vietnam if a greater percentage of cargo had been moved by containership. This could have resulted in dollar savings in ship reactivation and operating costs because of the requirement for fewer and more productive ships. Further, a cost comparison was made of the total cost of moving cargo in containers as compared to moving cargo breakbulk to Vietnam.²¹ This comparison indicated an average savings of \$14.56 per measurement ton when shipments are made by commercial container service. It can therefore be concluded that movement of 1.6 million MTONS of cargo to Vietnam by containership in 1969 resulted in an approximate cost reduction of \$23.3 million.

13. MANPOWER IMPACT. Maximum containerization in support of U.S. operations in Vietnam could have permitted some reductions in manpower requirements, particularly at the ports. Less man-hours are required at ports for handling containers (.05 man-hour per MTON as compared to .96 man-hour per MTON for loading and discharge of breakbulk cargo). This is a difference of .91 man-hour per MTON and is consistent with the Concord Ammunition Port Study figures previously mentioned. Additional manpower savings that may have been possible in depot operations under a total containerization concept result from the elimination of unloading and handling into storage of those materials that could be stored in the shipping container or delivered directly to the user, thus eliminating handling and reloading of that same material.

14. MODULAR FACILITIES. Some of the uses made of containers in Vietnam were for arms rooms, post offices, and communication huts. Permanent van-type facilities of this type do not necessarily fall into the distribution van-type container field; however, the characteristics and availability of transport van-type containers provide the basis for the development of van-type facilities for use in the field during the initial phases of any operation or for longer term use. Van-size modules could be designed to be assembled together in any flexible configuration for use as shelters, shops, and housing and storage facilities, thus reducing the need for extensive vertical construction during the initial or follow-on phases of any military operation.

15. SUMMARY. Economics are forcing industry to abandon breakbulk shipping and to adopt containerization. These same factors make containerized movement of military cargo inevitable. Although it is difficult to predict the total savings that can be achieved from the maximum use of containers, an estimate of the potential savings that would have occurred during the period of the Vietnam conflict (1965-1968) is shown in Table 1. Although insufficient data are available to permit quantification, potential additional savings, not shown in Table 1, include decreased loss, pilferage, and damage to cargo; decreased port facility requirements, such as cargo transit sheds; reduced packaging; and decreased numbers of ships required. Also, substantial savings in manpower required to support logistic functions in the overseas area and in the time required to accomplish the troop buildup could have been achieved.

²¹ American Power Jet Co., Report 589-3, MILVAN Pilot Operation Evaluation Pre-Introduction Phase, July 1969, pp. 3-2 to 3-4.

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TABLE 1

POTENTIAL RECURRING COST SAVINGS AND COST AVOIDANCE
WITH FULL CONTAINERIZATION IN SUPPORT
OF VIETNAM (1965-1968)²²

<u>Item</u>	<u>Amount (Millions)</u>
Recurring Cost Savings (1965-1968)	
Shipments (includes port handling)	\$344.6
Depot cargo handling	8.9
Total Recurring Costs	\$353.5
Cost Avoidance (one-time savings)	
Pipeline reduction	\$147.2*
Port facilities (piers)	181.0
Ship delay billings	89.7
Covered storage	86.9
Refrigerated storage	23.0
Total Cost Avoidance	\$527.8
Total	\$881.3

*At 1968 level of activity.

16. CONCLUSIONS AND RECOMMENDATIONS

a. Conclusions

(1) During the Vietnam era the use of the CONEX container and other small containers as well as the use of the large intermodal van-size containers for moving unit equipment, prebinned stocks, and resupply cargo clearly demonstrated the advantages of containerized shipments over breakbulk shipment and resulted in significant savings in cost, manpower, and time through reduction in cargo handling, pipeline investment, port facilities, storage facilities, shipping and loss, and damage and pilferage (paragraphs 2 through 11).

(2) Based on Vietnam experience and extensive studies, containerization offers a major opportunity to improve the logistic support to ground-based forces. Future efforts should be directed toward the development of specific systems for immediate implementation rather than further evaluation of the overall advantages and potential of containerization (paragraphs 2 through 11 and Appendix C).

(3) The increase in the percentage of container use by each of the Services and the recent successful shipment of ammunition in containers to Vietnam indicate the potential for broader military application of container service (paragraph 7).

(4) Cargo containerization in commercial operation will continue to increase and will result in a significant reduction in breakbulk shipping, and it is estimated that the amount of Department of Defense cargo moving in containers will increase until approximately two-thirds of all EOD dry cargo will move in containers (paragraph 2 and Appendix C).

²²American Power Jet Co., Report 589-5, Containerization Based on Lessons of the Vietnam Era, Ridgefield, New Jersey, January 1970.

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(5) Containerization is one of the highest potential payoff areas for reducing logistic cost in peacetime and future emergency operations. Containerization offers an opportunity for a great increase in efficiency of supply and transportation operations (paragraphs 7 through 15).

(6) To facilitate overseas movement and handling, the Services should incorporate standard van-container design characteristics in the future development of modular or portable facilities, such as shelters, shops, housing, communication centers, computer centers, command centers, and other advanced base functional elements (paragraph 14).

b. Recommendations. The Board recommends that:

(CN-1) Based on the sound economic case for containerization and uniformly favorable responses to Vietnam experience, the Department of Defense adopt a policy that all oceangoing military cargo that will fit in a container will move in a container, with deviations to this policy treated as clear-cut exceptions. (conclusions (1) through (5)).

(CN-2) The military departments exploit the use of containers by maximizing the use of containers for purposes to include:

- (1) Moving unit equipment to support deployments.
- (2) Prebinning of stocks when desirable to facilitate in-theater logistic operations.
- (3) General cargo distribution.
- (4) Temporary storage (conclusions (1) through (5)).

(CN-3) The military departments design portable facilities such as shelters, shops, housing, communication centers, computer centers, command centers, and other advanced base functional elements so that they can be moved as standard van-containers (conclusion (6)).

CHAPTER III
CONTAINER-ORIENTED LOGISTIC SYSTEMS

SECTION A

INTRODUCTION

1. GENERAL

a. To develop military logistic systems that are container-oriented presupposes the capability to support such systems. In the design of a system that will be responsive and effective, planners must recognize that all elements of the distribution system must receive consideration as a whole. Two key elements are supply and transportation, which involve the positioning of materiel. Supply operations are concerned with providing the materiel and controlling the distribution to ensure delivery or issue of the materiel, where, when, and in the quantity needed. Transportation addresses the movement means by which the materiel is provided. A containerized logistic system requires the integration of the elements of supply and transportation into a total system.

b. Based on Vietnam experience, container-oriented logistic systems concepts will be outlined identifying those administrative and resource requirements that must be satisfied if the full potential of containerization is to be attained within future military logistic systems and operations. In outlining and describing such concepts it is recognized that not all the prerequisites for container-oriented logistic systems may be identified, since the evolution and growth of containerization technology is dynamic. A complete and a bold commitment to container-oriented logistic systems will, of necessity, be paced by exploiting container advancements and capabilities as they are attained.

c. Two different but complementary systems, land-water-land and land-air-land, are indicated because:

(1) The criteria for design of air system containers and water system containers are quite different, although with standard modules and handling equipment they are married into a total system.

(2) Shippers at cargo origin will generally know with a high factor of confidence whether cargo offered for shipment will move by surface or by air.

(3) Two different but complementary systems, land-air-land and land-water-land, have developed in the air and water transportation industries creating an existing split in commercial container systems development.

(4) There is of course a requirement for systems coordination in the development of these programs—particularly in relation to design of modules and accommodation to standard trailers and materials handling equipment.

(5) The dual systems approach, with lateral coordination, is considered essential in light of the factors mentioned above.

d. These complementary systems are further discussed in the following two sections of this chapter. Section B contains a discussion of the supply distribution considerations and the elements and resources necessary for the land-water-land system. Section C contains a discussion primarily directed at those considerations for the land-air-land container system which differ from the land-water-land environment. Section D concludes the chapter with a discussion of the urgent and critical requirement for authoritative joint service efforts to develop container systems concepts.

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2. SYSTEMS CHARACTERISTICS. Areas that must be considered by Service logistic planners as well as by the joint Service effort in the development of optimum systems for utilization of containers within the Department of Defense (DOD) include the following:

- a. A peacetime system that ensures minimum systems changes and maximum responsiveness to limited and general war requirements.
- b. Recognition that although the commercial industry provides the prime support to DOD movement requirements, a military capability is required in the initial phases of contingencies or to support areas off normal trade routes.
- c. Effective and responsive coordination with emergency control agencies, e. g., the Office of Emergency Transportation.
- d. Optimization with all elements of distribution to include supply, transportation agencies, and the operating forces.
- e. Flexibility to accommodate to changes in requirements, capabilities, and procedures.

SECTION B

LAND-WATER-LAND DISTRIBUTION SYSTEM

1. SUPPLY DISTRIBUTION CONSIDERATIONS

a. Supplies Susceptible for Containerization. Most of the cargo that could not be containerized during the Vietnam era consisted of major end items of equipment. Following the buildup stage, when most unit deployments were completed, the percentage of the total surface cargo that could have been shipped in containers reached an estimated high of 75 percent of the measurement tons shipped. Overall, about two-thirds of the surface cargo shipped during this 4-year period could have been shipped in containers.

(1) Table 2 contains a summary of the cargo shipped by surface from the United States to Vietnam from 1965 through 1968 and an estimate of the amount that could have been containerized.

TABLE 2
POTENTIAL CONTAINERIZABLE SURFACE CARGO,
CONUS TO RVN, 1965-1968

<u>Calendar Year</u>	<u>Total Cargo (Thousand M/T)</u>	<u>Estimated Container- izable Cargo (Thousands M/T)</u>	<u>Percentage of Total</u>
1965	2,682	1,374	51
1966	6,800	4,064	60
1967	9,713	6,818	70
1968	10,238	7,644	75

Source: Appendix A, Tables 2-1 and 2-5.

(2) Only a small percentage of the potential containerizable cargo was shipped in containers during the Vietnam era. This was due to the lack of preplanned, formalized military requirements and the breakbulk oriented system, as well as a lack of readily available commercial container capability. Although containerization of DOD ocean cargo is increasing as evidenced by the statistics in Table 3, it appears that as a long-term goal, the Office of the Secretary of Defense (OSD), should strive for a near 100 percent target for containerizable cargo to be shipped in containers.

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TABLE 3
 PERCENTAGE OF TOTAL CONTAINERIZABLE
 CARGO SHIPPED IN CONTAINERS,
 GOALS AND ACCOMPLISHMENTS

<u>Service</u>	<u>Shipped</u>		<u>Goals</u>	
	<u>FY 69</u>	<u>1st Half FY 70</u>	<u>FY 70</u>	<u>FY 71</u>
Army	28	41	50	60
Navy	30	41	39	41
Marine Corps	20	35	22	24
Air Force	20	35	30	45

Source: Department of Defense, Status Report, subject: Logistics Performance Measurement and Evaluation System, 31 December 1969, p. 32.

(3) Container eligibility is based on both the physical characteristics of materiel and the effectiveness and efficiency of the total distribution system. High priority, infrequently demanded or intensively managed high-cost items are not normally considered eligible for containerization in surface movement. Supplies required in large quantities such as subsistence (including reefer), general supplies, construction materials, PX items and ammunition, for which future requirements can be forecasted with reasonable accuracy, offer the greatest potential for containerization by providing immediate improvement in the effectiveness of overseas supply operations for the Services. Containerization of these supplies would, in many instances, allow containers to be throughput to the ultimate consumer with commensurate economies in requirements for logistic resources at intermediate supply echelons, or, as a minimum, when used as temporary storage would relieve the intermediate echelon of much of the physical workload associated with storage of this type materiel.

(4) Shipments that require a full container for a single line item on a frequent basis such as tires, batteries, and paper products can be planned so that issues could be made directly from container. When the container is empty, it can be returned to the transportation system and replaced with a full container. For example, a unit would receive a container load of tires, and the container would be used to store the tires until issued. As the container was emptied, it could be replaced by another container load of tires and the empty container could be returned to the transportation system. The container would be used for brief periods in lieu of a covered storage facility.

(5) Reefer cargo is totally susceptible to containerization. A recent joint study, conducted under Defense Supply Agency (DSA) auspices for OSD, showed that 100 percent of military reefer subsistence items are containerizable and the use of refrigerated containers for the shipment of perishable subsistence for overseas support is cost-effective. The following data indicate the trend in DSA's increased use of refrigerated containers for overseas support:

1966 - 343 containers (west coast)
 1967 - 924 containers (east and west coasts)
 1968 - 12,459 containers (east and west coasts)

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The trend for military utilization would have been greater if more containers had been available to fulfill requirements.¹ Temporary reefer storage problems at origin and destination are minimized through the use of reefer containers that can be loaded for direct shipment to the user. Temporary storage using reefer containers on a rotational basis is both possible and practical and proved to be very economical and efficient during the Vietnam era.

(6) Recent Army test shipments of containerized ammunition² from five inland CONUS locations through the outloading port at the Naval Weapons Station Concord, California, resulted in faster ship loading time, shorter overall transit time,³ greater safety, and a possible reduction in pipeline inventory.

(7) Although nearly all types of supplies (and even end items of equipment) can be containerized, each Service, based on its logistic support responsibility and operating command requirements, must exercise the responsibility for determining what cargo should be containerized. This is as much a part of the Service support responsibility as is the determination of the quantity of material, to whom it will go, when it must be released, and when it is due at the consignee. Since the roles and missions of each Service are different, each must determine its particular needs in regard to containerization and how best to take advantage of the benefits to be derived therefrom. Cargo containerization determination should not remain static. As requirements and/or capabilities change, Service decisions relative to containerization must be examined for possible revision for further exploitation.

b. Consignor Considerations

(1) Mechanization of Warehousing and Shipping Procedures (MOWASP) has been implemented by the Services and the Defense Supply Agency to consolidate issues from each storage activity for each consignee to the maximum extent possible. This program promotes effective unitization and containerization of shipments.

(2) To take full advantage of containerization the consignor must be able to obtain a military or commercially owned container in a timely fashion. If containers are not readily available at points of supply origin (whether inland or within the commercial port zone) then consignors will continue to prefer breakbulk shipment methods to meet directed time standards.

(3) If the consignor cannot accumulate sufficient cargo for a full container load then he should have the opportunity and option of sending his material to a container consolidation point, or of having a family of different-size modular containers for consolidation and shipment to consignees. This latter system would maintain the integrity of less-than-container-load lots and still take advantage of the benefits of containerization even if an intermediate consolidation point had to be utilized.

(4) Flexibility in the choice of shipment methods must still be retained by the consignor so that the advantages of each method may be utilized. Since everything will not be shipped by container, all of the other shipping methods will continue to be used when they each meet the need of the particular shipper Service.

¹Defense Supply Agency, Report, Containerized Shipment for Overseas Perishable Subsistence Support, August 1969, pp. 2 and 94.

²Hq., USAMC, Report of Project TOCSA, 20 April 1970.

³1st Logistical Command, to JLRB, Message, 310918Z January 1970, subject: Sealand Ammunition Movement.

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c. Documentation

(1) Containerization offers a reduction in paperwork, particularly in the area of transportation documentation. Basically, there are fewer documents needed to ship a container load than to make many small shipments. With a fast-moving container operation, complete, easily understood and timely documentation is essential. For breakbulk cargo, documentation errors or omissions can frequently be rectified by the discharging terminal. However, with closed containers, documentation errors, for the most part, would not be noted until delivery to the consignee. This is too late and could result in critically needed items being sent to the wrong destination. Documentation techniques require further refinement and positive controls to ensure the manifest is of such quality as to preclude the need for opening the container and inspecting and identifying the contents prior to transshipment.⁴

(2) Documentation problems have plagued commercial operators in much the same way as the military. The Department of Transportation and the San Francisco Marine Exchange have accepted a one-page letter size form proposed for use by United States sea, air, rail, and truck carriers and shippers engaged in overseas trade. This form will probably be adopted, since a study by the National Committee on International Trade Documentation and the Department of Transportation showed that the present commercial documentation cost amounted to \$5 billion annually.⁵

(3) Although the military is ahead of commercial industry with the standardization afforded by Military Standard Transportation Movement Procedures (MILSTAMP), there will be a future need for a more sophisticated documentation system to permit identification of container contents and location of the container in the pipeline. This would not require too much refinement to the current military documentation systems but would be enhanced by more automatic data processing (ADP) capability at terminals and intransit points. In addition, documentation procedures will require the flexibility to adapt to new concepts or techniques such as the forward movement of modular containers without the loss of supply or transportation documentation integrity and also with a minimum administrative burden being placed on the transshipment point.

d. Consignee Considerations

(1) An evaluation of the role of containerization on the supply system requires some appreciation for the amount of cargo that must be handled by the different echelons of the overseas area supply system. The overseas supply system is basically comprised of the consumer echelon and one or more intermediate storage echelons. The storage echelons are established to pre-posit supplies closer to the consumer without burdening the operation and to accommodate the order and ship time surges that exist in the distribution system. The quantity of supplies handled at each echelon is sensitive to the system's basic concepts.

(2) Many benefits are to be gained by containerization even when circumstances require stuffing or unstuffing at intermediate points. An optimum system would containerize everything at source and move the container to the ultimate user. The size of the using unit, its location, accessibility, mission or other constraints all affect the capability of the consignee to accept and handle full container loads in a forward area. To the maximum extent possible, the stuffing point must be aware of the problems and restrictions of the consignees and plan container shipments accordingly.

(3) Another benefit of container operations will accrue when resupply requisitions can be grouped and considered as a request for one container full of assorted supplies warehoused in a container for one consignee in compliance with a standard overseas locator system.

⁴1st Logistical Command, After Action Report Project TOCSA, 17 - 21 January 1970.

⁵John T. McCullough, "Containerization Comes of Age," Distribution Manager, October 1968, pp. 41 - 51.

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Then, instead of the overseas activity having to open the container upon arrival and removing, inspecting, and receiving for each item, the container, upon receipt, can be spotted in the storage area, the locator and stock balance cards updated, and the materiel issued when required. Such a system would also alleviate the immediate requirement for covered storage in the initial phase of deployment. Ordering of supplies in bulk lots as opposed to single-line item requisitioning for small lots would allow block stowing.

(4) The utility of containers would be considerably enhanced if inserts (Figure 3) or modules were available to facilitate unstuffing operations, maintain consignee integrity of materiel, improve and simplify control of documentation while materiel is in transit, provide at least temporary protection from the elements, reduce pilferage, and increase the potential of intermodal transfer incident to the throughput of materiel to consumers. Except for items such as subsistence, ammunition, construction material, and general supplies consumed in large quantities, many retail level consumers or distribution outlets will not generate adequate requirements to effectively and efficiently use the capacity of an entire van sized container unless deliveries of materiel are delayed for the purpose of consolidation into full container loads. Because such delays will not be acceptable many times, modular stowable containers or the use of consolidation and distribution points will be necessary for a fully developed and successful system.

(5) Some of the variables that will influence both supply and transportation considerations in containerization are decisions on the categories of materiel that can be received in containers, consolidation by destination, consignees capabilities, or limitations for accepting and turn around of containers, and temporary storage requirements.

e. Movement and Supply Intelligence

(1) The containerization of a single commodity consigned to a single consignee presents no problem with respect to supply and transportation interface. When containers are stuffed for multiple consignees or with multipack boxes the current Military Standard Requisitioning and Issue Procedures (MILSTRIP) and MILSTAMP do not provide adequate and timely intelligence. The total supply visibility problem is compounded when material is sent through a consolidation point. As pointed out in Chapter IV of the Transportation Monograph, under current procedures the master Transportation Control Number (TCN) of each shipment unit in the container is perpetuated in the documentation; however, the ability to associate the master TCN with individual requisitions placed within the container is difficult and time consuming. Paper identification of the specific stock number or requisition number of the supplies in transit may not be readily available, but the need to identify each requisition will diminish because containerization provides a greater assurance of timely delivery of the supplies to the requisitioner than is the case in breakbulk operations.

(2) The use of container modules will materially assist in solving the documentation problem. Adaptation of documentation to permit module identification within a larger container will simplify necessary supply and transportation information. Logistic information systems such as exist at the Logistics Control Offices at Fort Mason, California, and Brooklyn, New York, and the Navy's ship locator systems can be used for location and diversion of critical supplies in containers. (See Figure 4.)

2. DEPOTS, MANUFACTURING PLANTS, AND CONSOLIDATION POINTS. To achieve maximum economy and other benefits of containerization, consolidation of cargo in containers should be accomplished at origin to the maximum extent practicable. Because of the different Service supply distribution systems, provisioning practices, transportation resource capability and availability, and other logistic considerations, sources of containerized supplies for movement to forward areas may be one of the following.

a. Depots. As noted previously, MOWASP provides the management tool by which supplies may be consolidated for shipment to forward areas. Containerization, however, also requires physical capabilities. Appropriate materials handling equipment (MHE) must be available to

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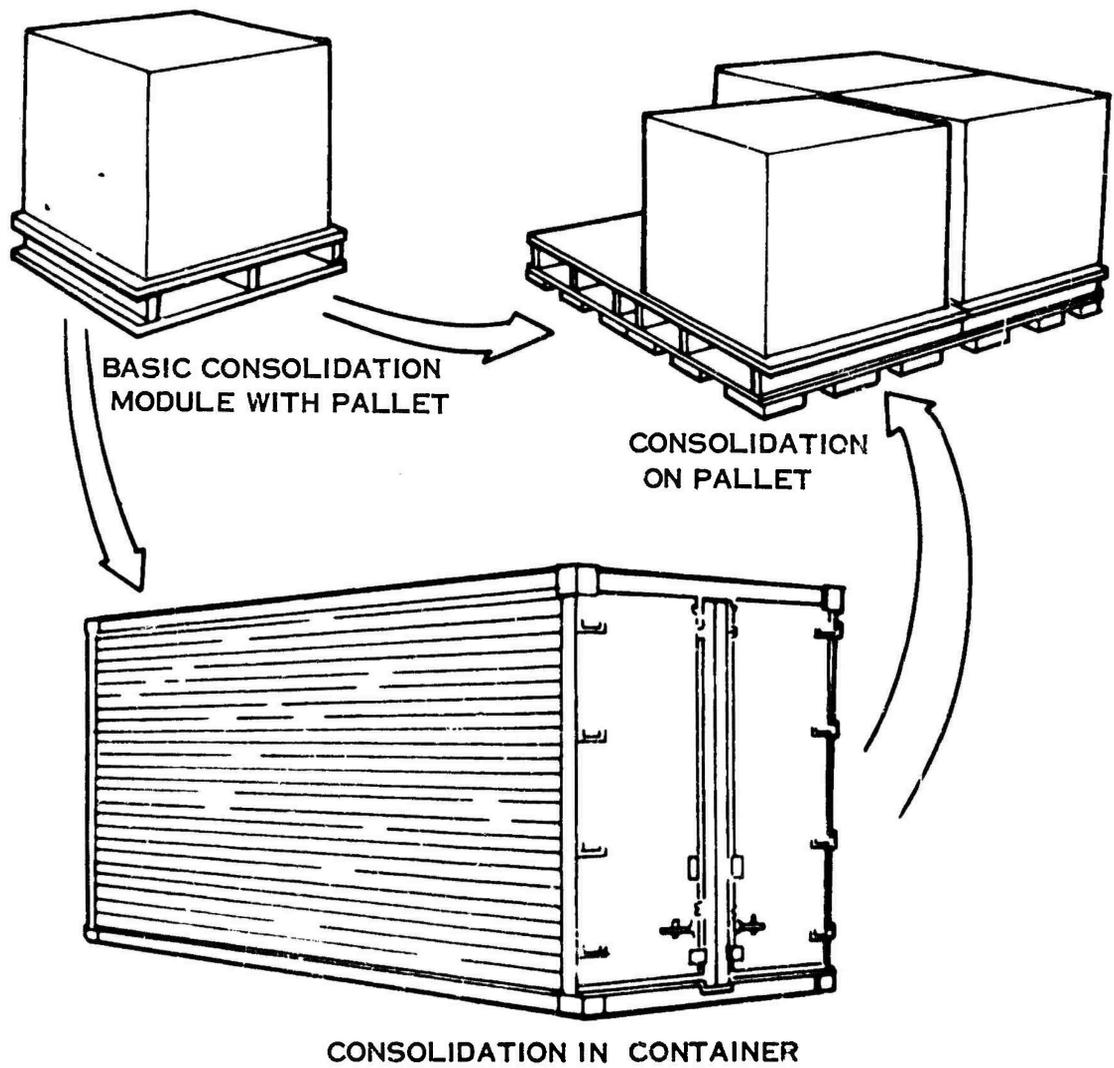


FIGURE 3. INSERT CONCEPT

(Small modules being placed on a pallet for further consolidation into a larger container.)

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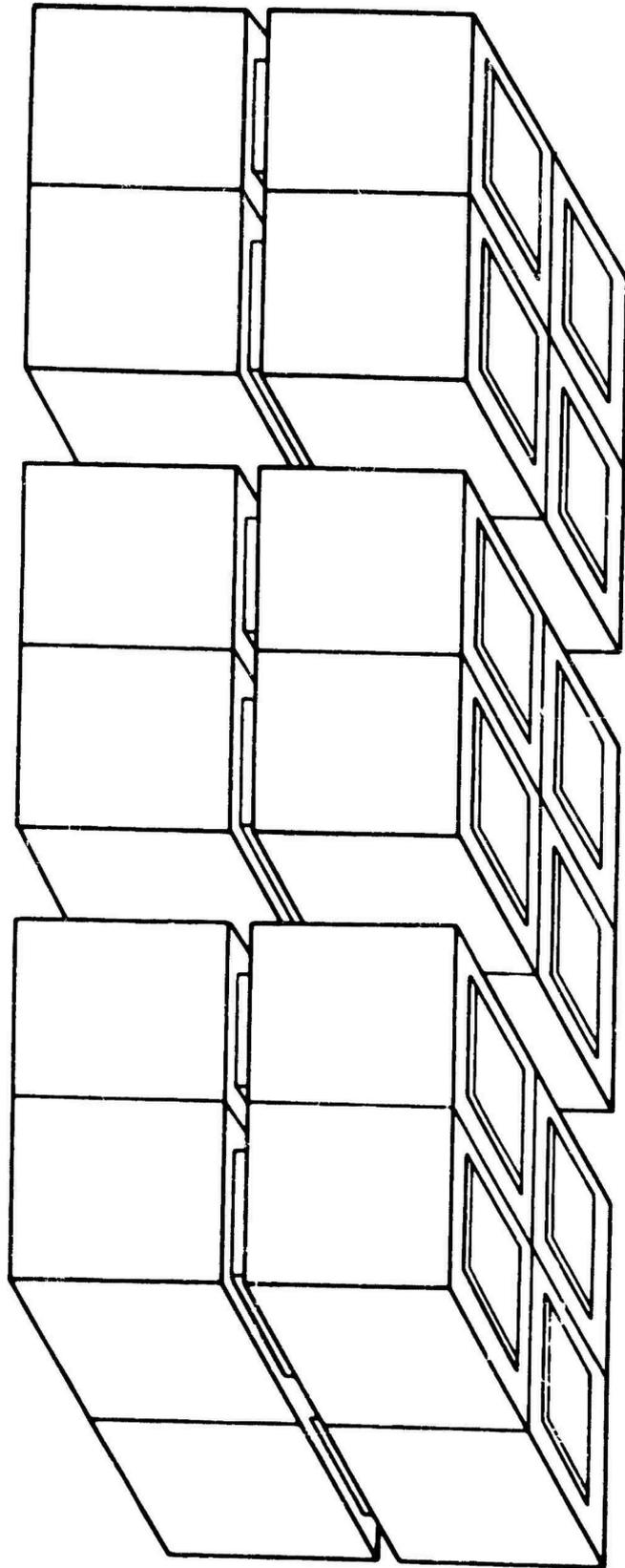


FIGURE 4. MODULES TO FORM 20-FOOT CONTAINER

(Smaller standard container capable of being coupled together to form a larger size standard container, e.g., three 8 by 8 by 6 2/3 ft. containers coupled to form an 8 by 8 by 20 ft. container.)

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facilitate movement and handling such as required for conventional movement by rail or motor carrier. Adequate marshalling area, to include hardstand, is required to permit ready availability of containers for stuffing. Containers that arrive at depots in semitrailer configuration require no special container transfer equipment other than a tractor for intra-depot movement. For those depots with rail heads and which receive and/or ship containers on flat cars (COFC), a container lifting device (crane or forklift of 50,000-pound capacity) (Figure 5) is required to transfer the container from the flat car to the chassis. Adequate chassis must be available.

b. Manufacturing Plants. These refer primarily to those plants that are either Government or commercially owned or operated which manufacture commodities in volume, such as subsistence and ammunition. The equipment requirements at these locations are similar to those described for supply depots, especially as they relate to the 50,000-pound lift capacity and chassis for intraplant movement. Cognizant elements of the DOD have responsibility to ensure that facilities and equipment are available to permit maximum efficient containerization of cargo. Containerized ammunition movements are currently restricted by intermodal transportability criteria. Service coordination with the U. S. Coast Guard and the American railroads is required to ensure that authority is granted for efficient containerized ammunition movement by rail compatible with ocean transport load restraint criteria.

c. Consolidation Points. These points, established to permit consolidation of small lot shipments into container loads, may be identified with the four following concepts.

(1) Depot Consolidation—Similar to that performed by Sharpe Army Depot, New Cumberland Army Depot, and other inland depots during the Vietnam era. For this operation the physical requirements would be similar to those required at the supply depot described previously. Facilities for receipt, holding, and consolidation of the small-lot shipments, as well as procedures for control and documentation, would need to be identified and ensured. Service supply distribution policies and procedures would need to be examined for possible revision when this concept is adopted by the affected Services.

(2) Port Terminal Consolidation—Similar to that performed at the Military Ocean Terminal, Bay Area. Terminal stuffing of containers should be kept to a minimum; however, it will continue to be required for those supplies that generate in the port terminal area. Requirements for these procedures are similar to those performed by the inland depot consolidation points.

(3) Vendor Consolidation—As resources permit and through-movement system procedures are refined, there will be an increased potential for containerized movements of direct vendor shipments to overseas destinations. The Defense Contract Administration Service in performing the traffic management role in contract administration will need to have the closest possible coordination with the procurement elements of the Services, the Defense Supply Agency, and the transportation operating agencies, to ensure that the relationship of containerization and Service procurement policies are recognized and responsive to the container oriented Service logistic systems.

(4) Other Consolidation Points—For example, the small shipment consolidation efforts of Military Traffic Management and Terminal Service (MTMTS), designed to support containerized movements to Vietnam and also to reduce CONUS line haul charges to west coast water terminals, can be oriented to a source to user concept as capability is expanded to permit integrated land-water-land container movements.

3. PROCEDURES FOR MOVEMENTS OF CONTAINERS

a. Current Procedures. As described in the following paragraphs, there are presently four administrative procedures for the movement of containerized material. (In the following discussion the shipping activity is the user of the container service.)

(1) Breakbulk. This procedure is the means by which the CONEX container and other small containers movements are currently made. The container is offered for shipment

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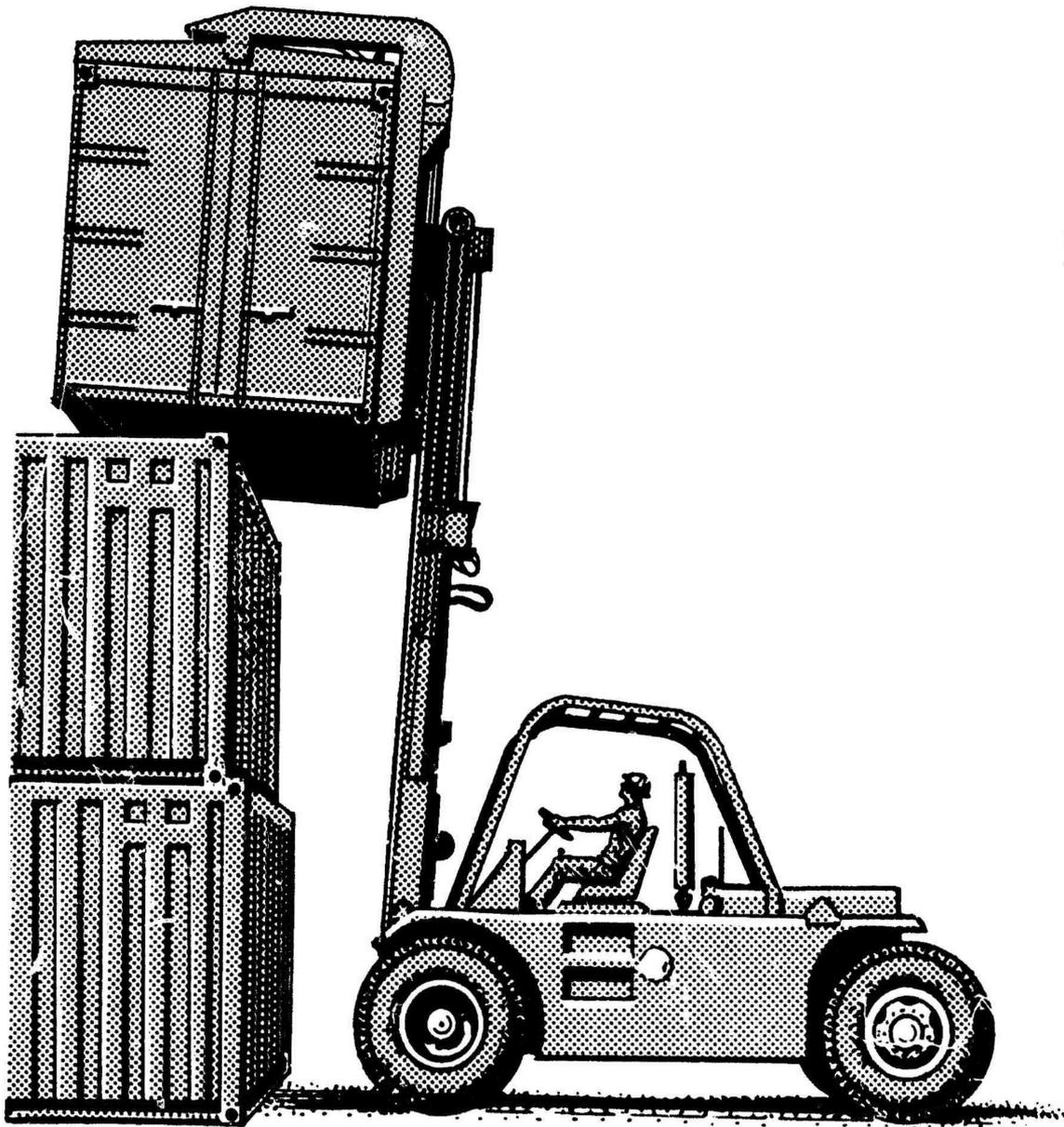


FIGURE 5. FRONT LOADING FORKLIFT TRUCK

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by the shipping activity to MTMTS. In turn, MTMTS offers the shipment to the Military Sea Transportation Service (MSTS), which books the cargo to a ship. The MTMTS advises the shipping activity to send the container to a specific port where it is held until the appropriate ship comes on berth. The container is then loaded aboard the ship and moved to the overseas port, where it is discharged and moved onward to its destination by transportation arranged by the overseas command.

(2) Through Government Bill of Lading. A Through Government Bill of Lading (TGBL) service is characterized by a single commercial contractor being responsible in accordance with an approved tender filed by a land or an ocean carrier, for the movement of cargo between origin and destination points utilizing commercial resources. Although a CONUS inland carrier, an ocean carrier, and an overseas inland carrier may be involved, there is single responsibility for the total movement. One Government Bill of Lading is issued that covers the total through service provided at a through-rate. Although ocean rates are shown separately to comply with existing laws the cargo moves under the auspices of the commercial carrier, normally through commercial facilities, and does not routinely incorporate all provisions of MILSTAMP, e. g. , there is no ocean cargo manifest prepared by MTMTS. A TGBL may apply to a single commodity or to broad categories of cargo. In addition it may provide for service between two specific points or may cover service from a number of points at origin to a number of points at destination. Under existing DOD policy, the authorization of Military Airlift Command (MAC) and MSTS to use TGBLs is restricted to shipments originating at air or ocean terminals or within the Interstate Commerce Commission defined port commercial zone.⁶ Some TGBL arrangements provide that further transportation from the overseas discharge port to the inland destination may be furnished either by the contractor or by the overseas commander. Under the TGBL method, MTMTS advises the shipper which carrier to use and, from that point on, the arrangements for the movement of the cargo are made by the shipper and carrier. For record purposes, MSTS is advised by MTMTS of which ocean carrier is involved in the TGBL movement.

(3) Container Shipping Agreement. This procedure provides for service between the port commercial zone in CONUS overseas terminals and inland points in overseas areas at the option of the overseas commander but specifically does not provide at present for through service from inland CONUS points. The container agreement is established by MSTS making annual solicitations to ocean carriers for container service. The agreement sets forth terms and conditions including separate rates for each segment, i. e. , (1) pier-to-pier service for each trade route, (2) drayage within the port commercial zone in CONUS and (3) in some instances, line haul rates for inland movement in overseas areas. The agreement also provides for the carriage of Government-owned or -leased containers. The competitive position of each carrier is protected for 1-year based on the rates submitted in response to the annual solicitation. Under the present system, MSTS determines the low cost carrier and orders service through an MSTS shipping order. The ocean carrier is responsible for the through movement and MSTS pays the carrier from the Navy Industrial Fund for that service covered by the shipping agreement. All cargo moves under the direct control of the military, including movement through military owned or controlled facilities and also incorporates most provisions of MILSTAMP. If inland movement is involved within CONUS, MTMTS coordinates with MSTS in providing the shipper with all necessary information including routing of the container to the applicable ocean terminal.

(4) Contract Service. Both the TGBL service and the container agreement are associated with established service, i. e. , ocean carriers serving designated overseas destinations. These types of service were not available to support operations in Vietnam and led to the fourth procedure, which is associated with contract service arranged between MSTS and a specific ocean carrier. This service included commitment of a specific capability and number of scheduled sailings. It also included the use of contractor CONUS terminals, line-haul equipment, materials handling equipment, and management. Guarantees were provided as to the

⁶ OSD (A.L.), Memorandum, subject: Through Government Bill of Lading (TGBL) Transportation, 10 July 1965.

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tonnage that would be shipped. Under this procedure, the military shipper notified MTMTS of the requirement; MTMTS arranged for transport of the container to the shipping activity, if beyond the port commercial zone, and the shipper stuffed the container and moved the container to the designated loading port. The contract generally was oriented to the port commercial zone; however, MTMTS did arrange for some movement to and from specific inland depots.

b. Movement to the Port. Actual movement of the container from the stuffing point to the water port may be accomplished via rail using either trailer on flat car (TOFC) (Figure 6) or container on flat car (COFC) (Figure 7) service depending whether the container has moved with or without chassis. Over-the-road movement may also be performed when the container is in semitrailer configuration. Drayage within the port commercial zone is normally over-the-road. Line-haul movement arrangements within CONUS are normally arranged by MTMTS. Overseas, the line-haul arrangements may be part of the particular service provided or arranged by the overseas commander. Drayage within the CONUS port commercial zone may be part of the particular service provided or arranged by MTMTS or MSTs. Overseas, drayage is normally included within the shipping agreement, but may be arranged by the overseas commander.

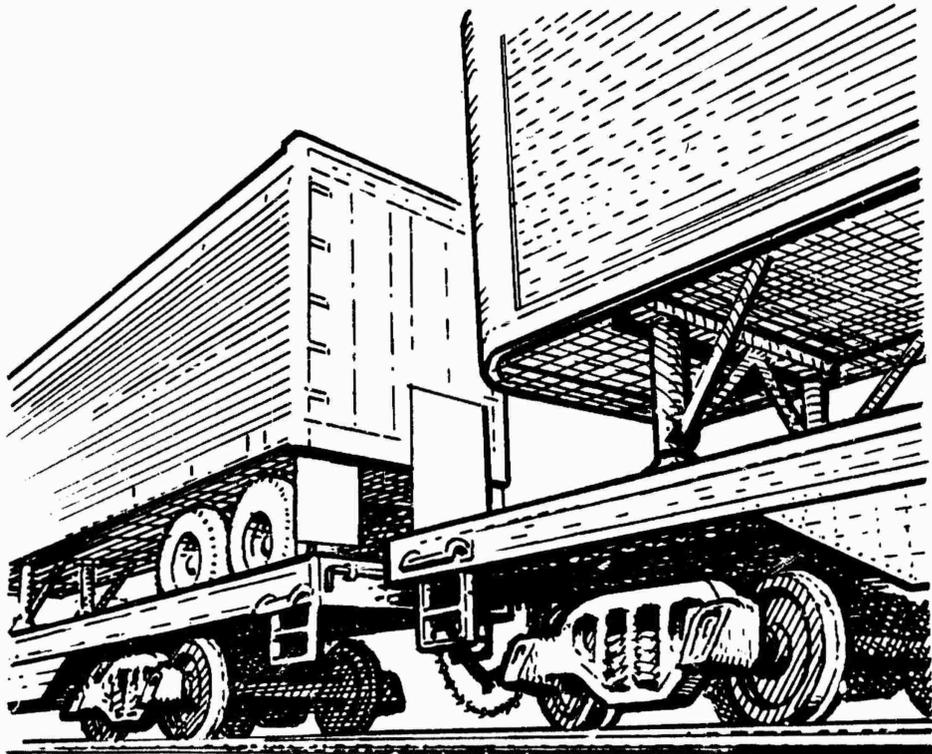


FIGURE 6. TRAILER ON FLAT CAR (TOFC)

(The Movement of a Trailer on a Flat Car (Van-Container).)

CONTAINERIZATION

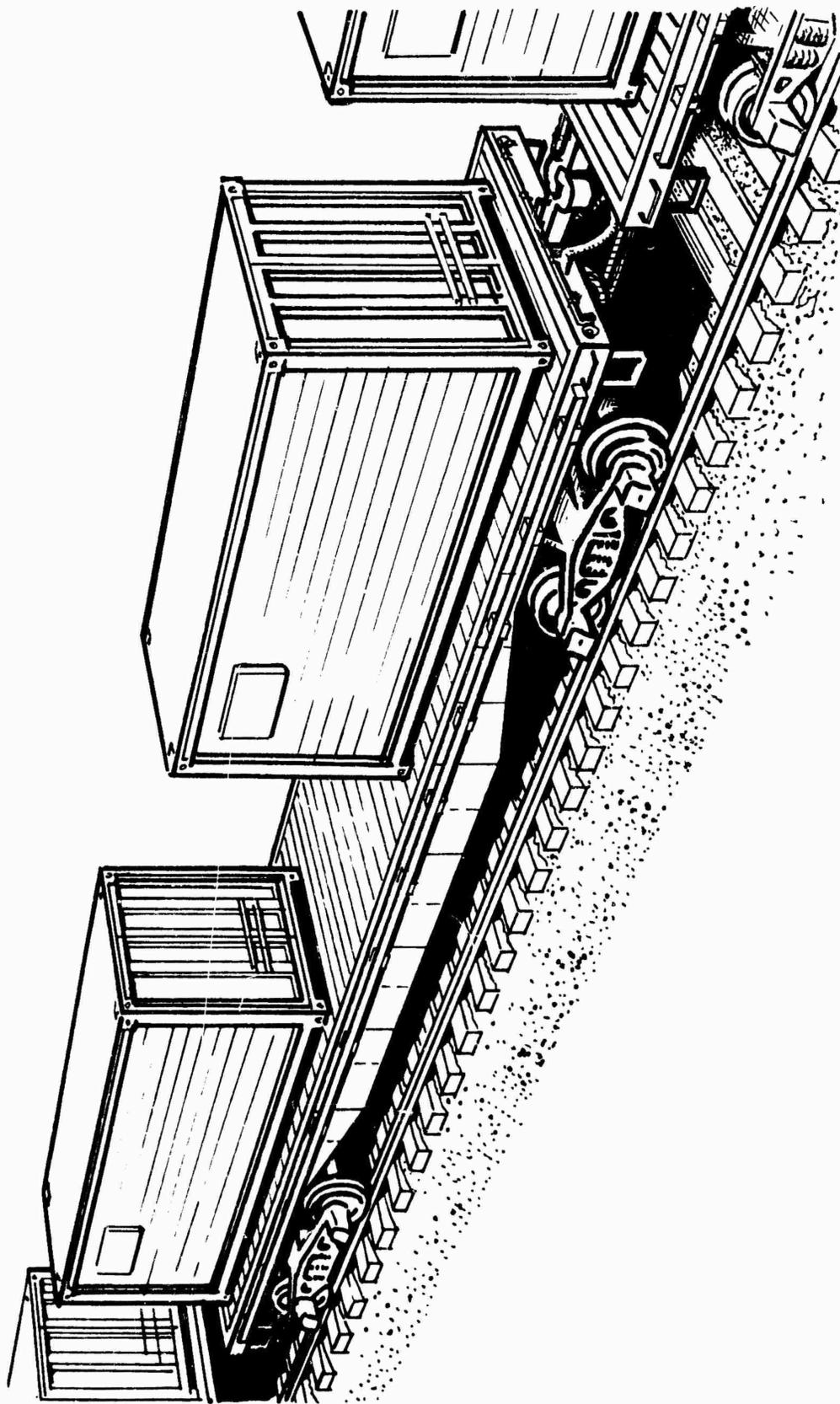


FIGURE 7. CONTAINER ON FLAT CAR (COFC)

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c. System Difficulties. Even though considerable flexibility and some efficiency exists within the four procedures described, an integrated routing of containers has not yet been developed. Major advancements are required if optimum systems integration is to be achieved. However, improvements that are made must ensure that transportation services are responsive to the systems' concepts and requirements of the users.

(1) Obtaining Rates. Transportation rates have been established separately for each segment of the transportation system for breakbulk shipments. Through-container rates from inland CONUS origins to inland destinations overseas (and vice versa) have not been readily available. The development of through rates would facilitate the establishment of integrated routings of containers by any mode of transportation from origin to destination. Each segment of a through rate could be identified separately. The lack of through rates has hampered the extension of container movements to and from inland points and has fostered continued breakbulk operations. Formerly, regulations governing ocean carriers prohibited them from filing through rates and through routing except on a case-by-case basis with a line haul carrier. The regulations have been revised by a ruling of the Federal Maritime Commission on 15 April 1970.

(2) Availability of Containers. The availability of large intermodal containers has been limited by an inadequate inventory of containers, almost all of which are commercially owned; the lack of container interchange agreements; the fact that many of the containers are of sizes peculiar to a single ocean carrier; and the lack of commonality of handling equipment in the carriers' systems. Availability can be improved substantially by standardization, container interchange agreements between the owners, and a larger commercial and military inventory of containers. In particular, the lack of interchange agreements has prevented shippers from using readily available containers belonging to one commercial carrier while containers belonging to another carrier have to be obtained and positioned for use. A closely related area that requires additional emphasis is the leasing by the military of commercial containers for intermodal movements.

(3) Container Booking Procedures. Except for the relatively few TGBL container shipments, container movements are made under contracts through container agreements or special controls of affreightment. After the military shipper identifies his container requirement to MTMTS, MTMTS places the requirement on MSTTS. Then MSTTS determines carrier capability and evaluates tonnage distribution and cost considerations. Once the ocean carrier has been selected, MTMTS is advised and the necessary traffic management information is provided the shipper to permit him to obtain the container, stuff it, and move it to the designated water terminal. The essential problem is that the procedures are segmented and do not promote integrated movement by the land-water modes. There is a potential for increased integrated movement of containers from inland points in CONUS through additional TGBL service and/or by expanding container shipping agreements to cover shipments originating outside the port commercial zone.

(4) Other Considerations. Other traffic management and military considerations have also impacted on container procedures and utilization. These other considerations included required equitable tonnage distribution between carriers; reduced transportation charges resulting from utilization of transit privileges at depots; the need to support military capability such as the military ocean terminals; balanced use of the MSTTS nucleus fleet and U.S. merchant marine; and the use of contracts and arrangements with the shipping industry to obtain commitments for the use of ships in emergencies.

4. CONUS OCEAN TERMINALS. Containerized shipment of cargo has caused considerable modification in commercial water terminal operations owing to the savings possible through reduced cargo handling costs and reduced ship turnaround time. New requirements have impacted terminal design in the areas of functions, layout, and mechanization. Under the present concept of container operations, the main pier areas are dedicated to the uninterrupted flow of cargo between the inland transport mode and shipside and with all terminal facilities

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intensively utilized. Containerships are frequently discharged and reloaded at pier side in 24 to 48 hours as compared with 10 to 14 days for breakbulk ships. These concepts are equally applicable to both military and commercial container facilities in CONUS.

a. Container Port Design

(1) The layout for a modern container port in CONUS (Figure 8) must give careful consideration to access by rail as well as highway transportation. Sufficient space should be provided for efficient rail and highway container marshalling areas with room for assembling vans for loading aboard ship and for holding vans awaiting transport to their inland destination. Approximately 12 to 15 acres are required to provide for marshalling each 1,000 containers 20 feet in length. This requirement is predicated on single tier container unit (on or off chassis) parking where sufficient space is available in the port. If marshalling land is critical, containers could be stacked up to three to five high using straddle carriers (Figure 9) or overhead cranes. Where land is cost prohibitive or unobtainable, multistory container warehousing may be desired.

(2) Other functions incident to cargo handling must also be provided for but not necessarily in the immediate area of ship pier operations. These include administrative services, customs examination and clearance, and consolidation of less than carload and truckload cargo into full container loads (stuffing), and unstuffing of containers designated for breakbulk distribution.

(3) Introduction of Lighter Aboard Ship (LASH) and Sea Barge Carrier (SEABEE) operations will also require the development of facilities for staging containers and other cargo for loading or discharging onto the barges, which are an integral part of these two systems.

b. Facility Requirements. The three major areas of concern in the development of facility requirements to support container operations are the piers, marshalling areas for holding containers, and a covered facility for stuffing and unstuffing containers.

(1) Suitable deep-water piers are required for the efficient handling of modern oceangoing containerships. With the continuing expansion in the size of these ships, adequate pier frontage and alongside water depths must be provided. It would also be desirable to have the piers equipped with a roll-on/roll-off (Ro/Ro) interface to provide the flexibility of handling combination Ro/Ro containerships, such as the multipurpose ships, as well as straight containerships. Shallow-draft pier space must then be made available to support the loading and discharge of the barges integral to the LASH and SEABEE operations.

(2) Container stuffing and unstuffing facilities are required in the terminal area to consolidate small lot cargo shipped into the terminal as individual shipments and to unstuff those containers necessary to permit onward distribution of small cargo lot to inland consignees. As long as the majority of containers are stuffed in the port commercial zone, the space requirement will remain large. As more containers are provided to the inland consignors for stuffing at origin, the size of the facility required in the terminal area can be reduced. This facility should be located so as not to impede the smooth flow of containers from the marshalling areas to shipside and vice versa. Sufficient MHE must be provided to support this operation.

(3) Marshalling areas must be located near to the pier area to provide for marshalling containers for loading aboard ship and for holding containers awaiting movement to their inland destination. This total requirement can be computed generally in terms of needing 12 to 15 acres for each 1,000 containers (20-foot length on or off chassis) to be staged in a single-tier configuration. Where areas available for marshalling are critical, smaller areas can be utilized provided that the containers are stacked and that sufficient container handling equipment is provided to support the type of storage elected. The use of multi-story container warehouses is a feasible alternative and would permit reduction of the marshalling area required.

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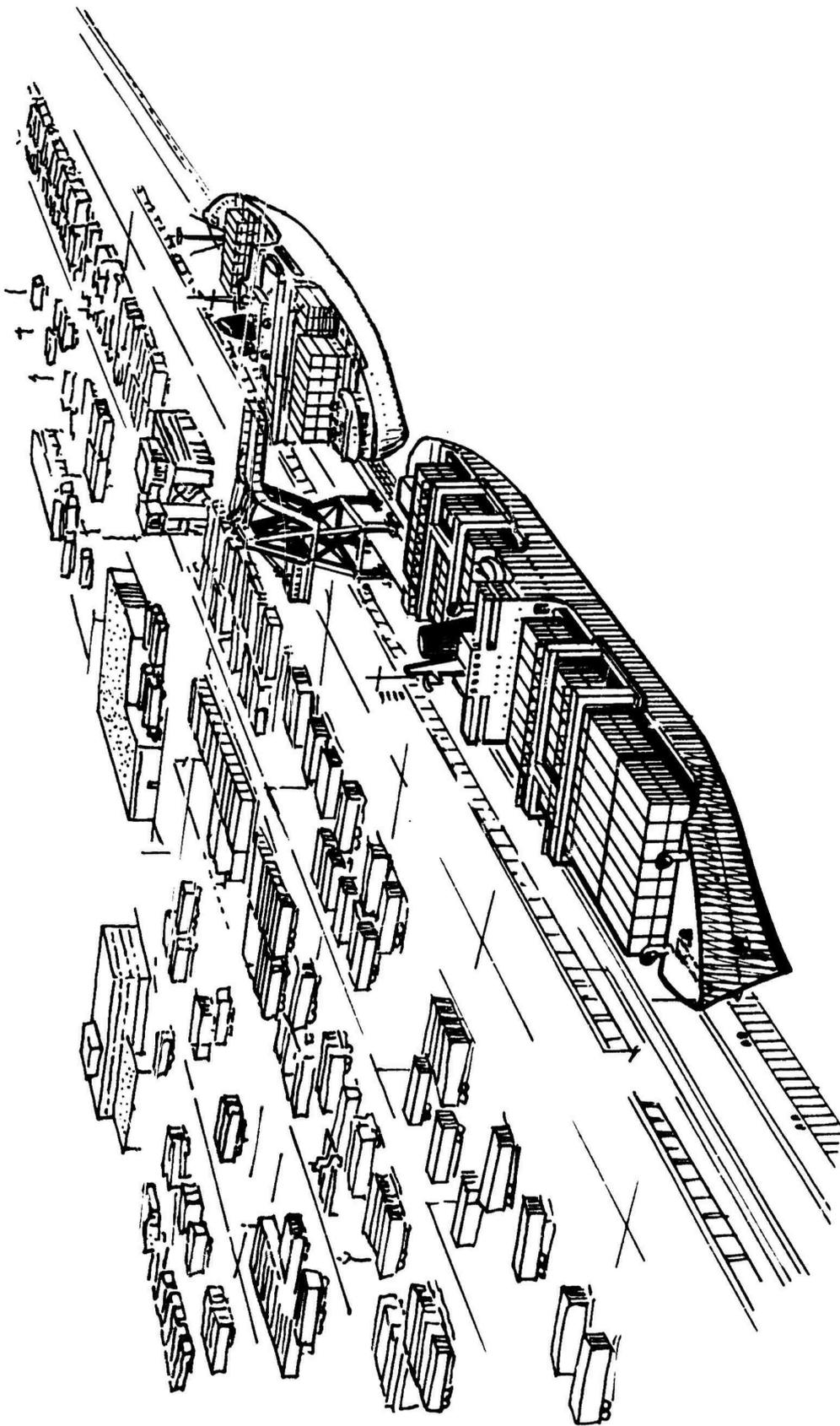


FIGURE 8. TYPICAL CONTAINER MARINE TERMINAL

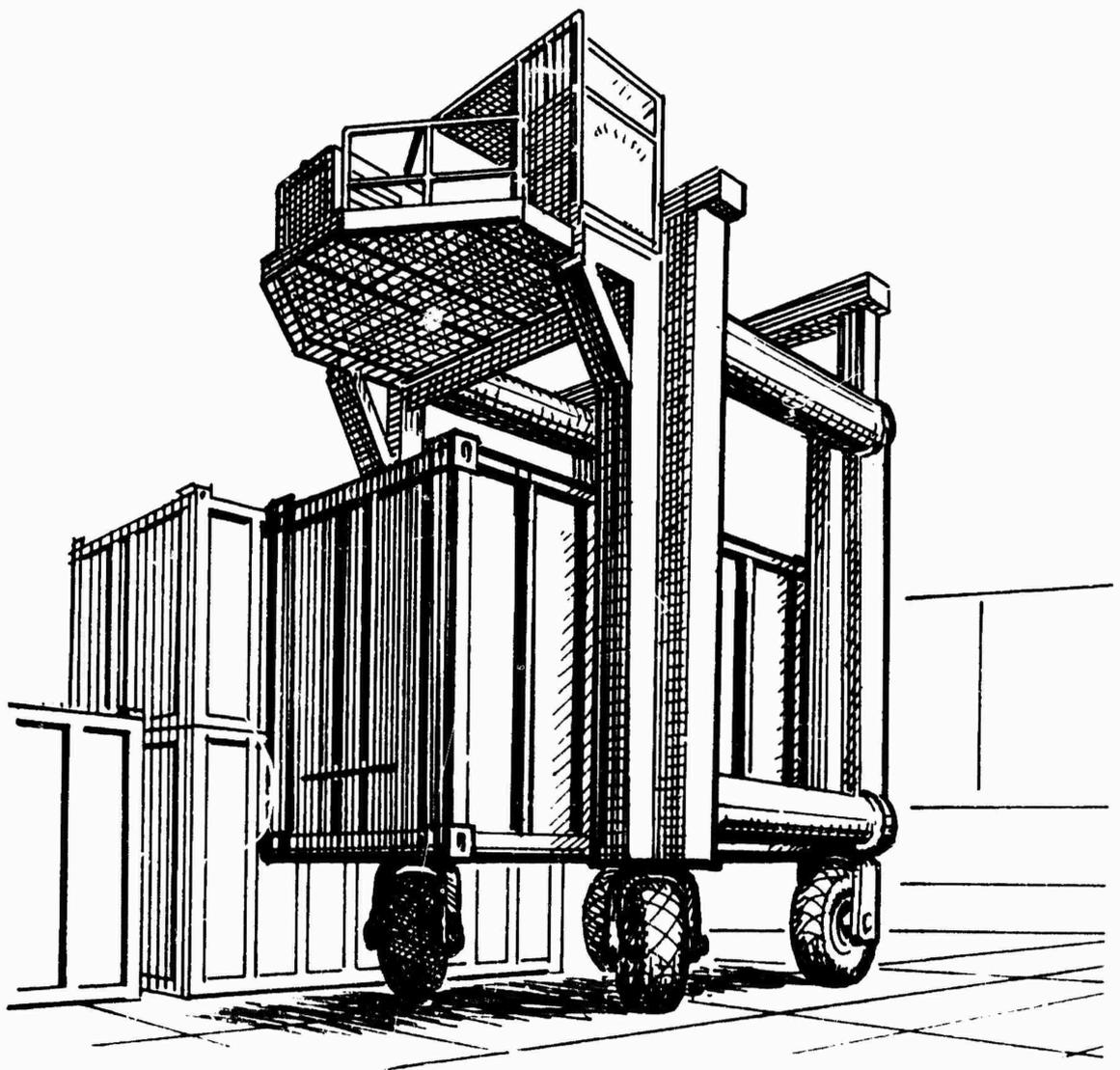


FIGURE 9. STRADDLE CARRIER SUITABLE FOR MOVEMENT AND STACKING OF CONTAINERS

CONTAINERIZATION

c. Container Handling Equipment. Container handling equipment is at essentially the same stage of development as the container itself. Because of the wide variety in types of equipment that have been developed by the commercial container operators, the military has a number of options available for selecting the types of equipment desired for a modernized container facility. This range of options, however, will be narrowed by the determination of the type of terminal operations that will be employed. For example, a system relying predominantly on the horizontal storage of containers, on or off chassis, requires one variety of handling equipment, whereas a system utilizing vertical storage of containers generally requires a different type. Container handling equipment falls generally into two categories—that required for ship-to-pier transfer and that required for terminal operations.

(1) The transfer of containers from pier to ship and ship to pier is normally accomplished by the use of ship- or pier-mounted gantry cranes. Although the ship-mounted cranes provide an often valuable self-sustaining capability, and permit the ship to call at ports lacking in special handling facilities, they also restrict the number of containers that can be loaded aboard, as well as dedicating the crane to one ship whereas shore-based cranes service many ships. For reasons of economy, the commercial trend is toward the procurement of the larger, faster nonself-sustaining variety of containerships that require the support of some variety of pier-mounted heavy-lift crane. The pier-mounted gantry cranes (Figure 10) such as those employed at Cam Ranh Bay and at most commercial container facilities in CONUS are the most desirable ship-pier transfer devices available. This pier-mounted crane has a high container transfer rate with major emphasis on speed and control and can service a fleet as opposed to one ship. It also has the advantage of being able to work ships with conventional cargo gear and the ability to reach two or more lanes of traffic on the pier as compared to the ship-mounted crane, which normally has limited reach and can service only one lane of traffic on the pier apron. Other less desirable devices used for ship-pier operations, include the use of heavy-lift house cranes fixed to the pier, and heavy-lift crawler (Figure 11) or floating cranes. The transfer of containers by the various lifting devices was greatly facilitated by the development of spreader frames equipped with automatic self-leveling devices and automatic container hooking devices matching with the container corner fittings used. The self-leveling devices incorporated into the spreader frames assure that the container will be maintained horizontally during handling operations no matter where the longitudinal or transverse center of gravity of the container might be located.

(2) The types of equipment required to support terminal operations are essentially determined by the type of terminal operations to be employed. For example, a system relying predominantly on the horizontal storage of containers or chassis would require the availability of a sufficient number of chassis to support the staging of shipload lots and sufficient hardstand for parking the combined units. On the other hand, it would require procurement of a minimum number of other more sophisticated lifting and transfer devices. Terminal operations employing horizontal storage on chassis or some type of stacking system, however, require the availability of a family of lifting and transfer devices to move the containers between transport modes as well as into and out of storage sites. The variety of items of equipment developed by the commercial operators that are available for use in military terminals include lifting systems such as air cushioned pallets, railway overhead straddle cranes (Figure 12), straddle carriers, towainers, tilting systems, and jacking transfer systems.

(3) Although DOD supports the concept of container standardization, until greater standardization of commercial container systems is realized the military must have the capability to employ the variety of systems available to support future contingency operations with a long-range goal of overall systems standardization.

d. Terminal Modernization. As the trend in commercial ocean shipping continues to swing increasingly toward containerization, the military ocean terminals will need to be modernized to ensure the availability of a cargo handling capability compatible with the shipping provided.

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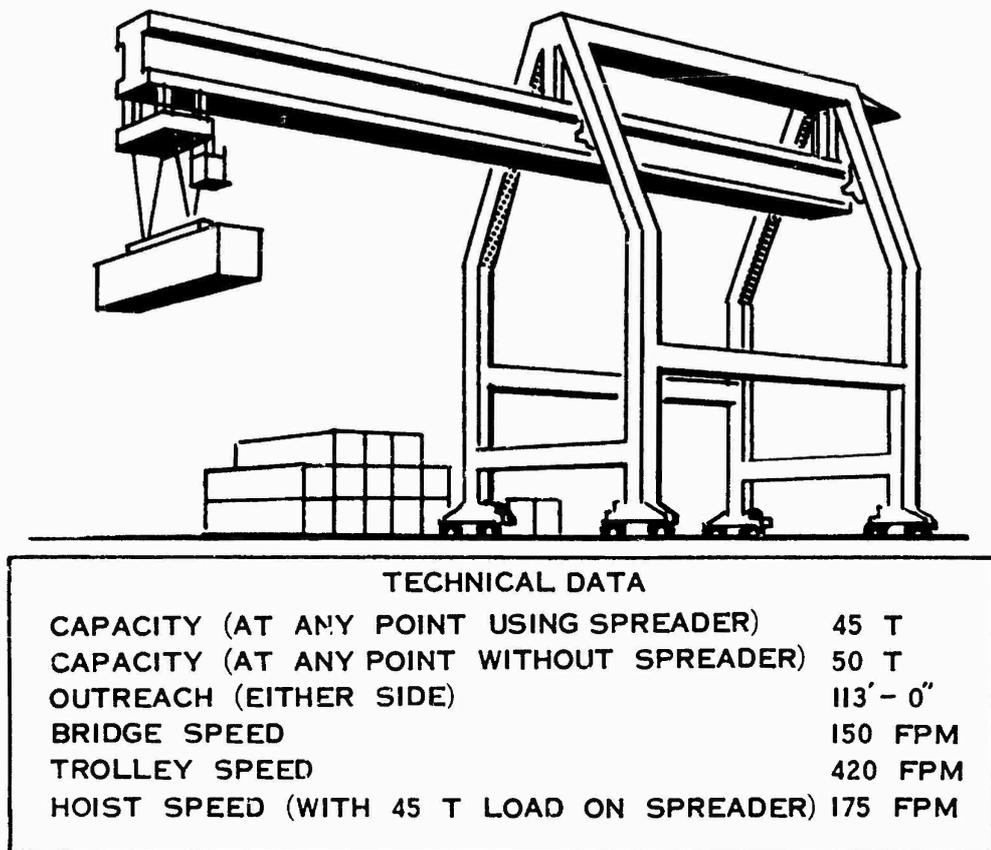


FIGURE 10. PIER-MOUNTED GANTRY CRANE

CONTAINERIZATION

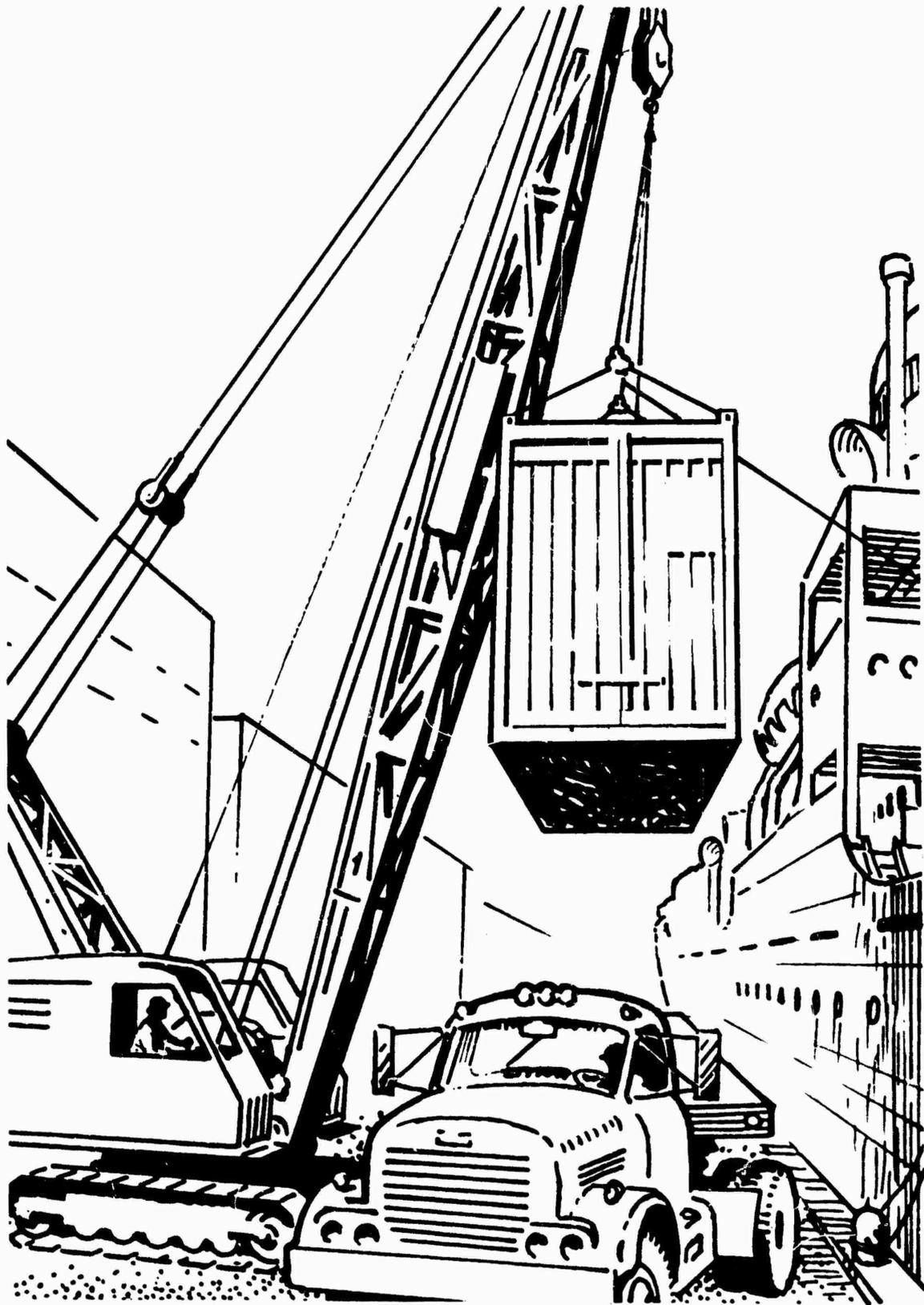


FIGURE 11. CONTAINER SHIPLOADING BY PORTABLE CRANE

CONTAINERIZATION

(1) Plans have been prepared for the modernization of the two major military ocean terminals at Bayonne, New Jersey, and Oakland, California. These plans call for the provision of a container-handling capability at these general cargo terminals suitable for handling self-sustaining and nonself-sustaining ships as well as the combination Ro/Ro containerships and multipurpose ships.

(2) A number of detailed studies have been made of the construction of modern container handling facilities at the major ammunition ports in CONUS. These studies indicate that significant potential savings could be obtained through increased containerization.

5. CONTAINERSHIPS

a. Background

(1) The ship plays a major role in an integrated transportation container system. A containership can load and unload more cargo and be recycled faster than a breakbulk ship, thereby significantly reducing pipeline time. Economic factors in commercial shipping operations favor the construction of fast (20 knots+), large (625 to 675 feet), deep-draft (31 to 35 feet) nonself-sustaining containerships that are completely dependent on shore-based facilities.

(2) The major steamship lines serving the North Atlantic have been withdrawing conventional ships as quickly as they introduce containerships; some lines already have completely abandoned their breakbulk service.⁷ A major international commercial competition is taking place in the North Atlantic and it is highly probable that a reversal in the balance of power between the U. S. flag and foreign flag commercial fleets will result. Of the total North Atlantic container lift in service at the end of September 1968, 77 percent was U. S. flag. With foreign flag lines belatedly expanding, the U. S. proportion probably will shrink to about 60 percent by the end of 1970. This probably will be sufficient to carry all the containerizable liner cargo then available.⁸

(3) The current generation of commercial containerships includes the following types: cellular containerships, combination Ro/Ro containerships, LASH, and SEABEE. (See Figures 14, 15, 16, and 17.) In addition, conventional breakbulk ships can carry limited numbers of containers whether on deck or below deck (Figure 13). Containerships of the future will be designed as elements of integrated distribution systems. They are expected to be highly specialized, fast, large, full automated, and completely custom designed to terminal facilities.⁹

(a) Combination Ro/Ro Containerships. In addition to the "pure" Ro/Ro ships, some commercial operators are turning to combination Ro/Ro containerships instead of cellular containerships. Since 1967, an international consortium of six foreign lines has been operating four combination trailer-containerships with room for 520 20-foot or 227 40-foot containers plus as many as 1,150 automobiles (or lesser numbers of trucks, trailers, bulldozers, etc.) One commercial operator initiated trans-Atlantic service in May 1969 with a fleet of four new 26-knot Ro/Ro containerships.¹⁰ Otherwise no U. S. container service operator has elected to rely on Ro/Ro containerships. Another private ship line that charters its only Ro/Ro ship and its entire fleet of lift-on/lift-off "freight car-containerships" to MSTS, has opted for cellular containerships for commercial use. Although the commercial operators are investing in the nonself-sustaining cellular ship concept, militarily, the combination Ro/Ro containership is more advantageous. The multipurpose ship (MPS), now in the DOD Five Year Defense Program (FYDP) would be a self-sustaining combination Ro/Ro containership, with additional military characteristics.¹¹

⁷ Joint Chiefs of Staff, Special Assistant for Strategic Mobility, MOVECAP Corollary Study: Use of Containers in Military Operations, 16 December 1968, pp. 32-33.

⁸ Equity Research Associates (ERA), Containerization, 16 May 1969, p. 2.

⁹ Joint Chiefs of Staff, Special Assistant for Strategic Mobility, op. cit., pp. 34 and Appendix A, page 4-9.

¹⁰ "Roll-on Ships Gather More Cargo," Business Week, 10 May 1969, p. 74.

¹¹ See Transportation Monograph, Chapter III, JLRB Report.

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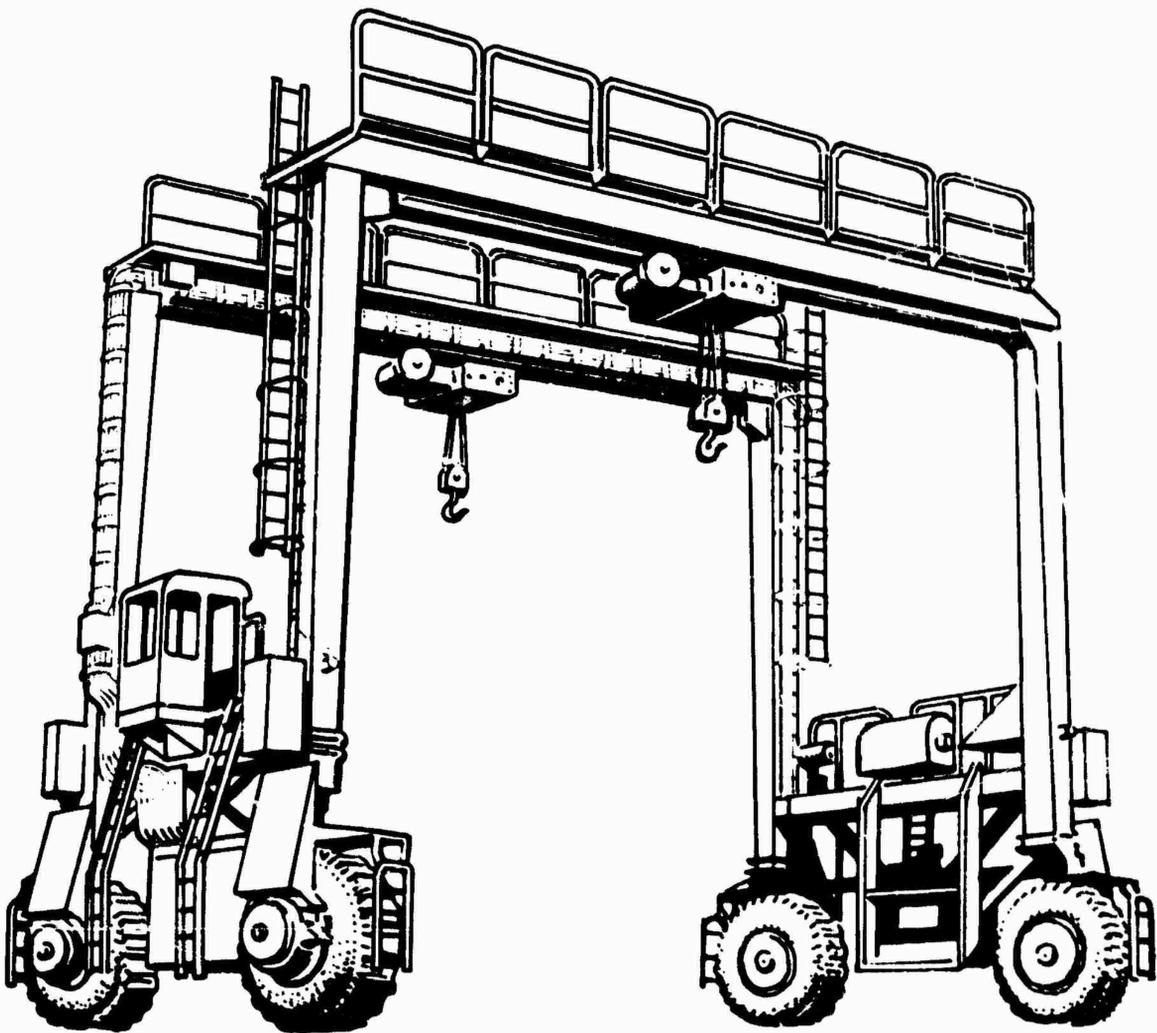


FIGURE 12. RAILWAY OVERHEAD STRADDLE CRANE

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FIGURE 13. CONVENTIONAL BREAKBULK CARGO SHIP

(This type of ship operating in a berth line service provides a container service as a part of its general cargo offering to the shipping public. In this type of operation both cargo containers and van-containers can be carried. The smaller cargo container is carried in the 'tween decks in such a position that only vertical (in and out) movement will be required. They are also carried on deck, as are van-containers, using special built-in supports or foundations.)

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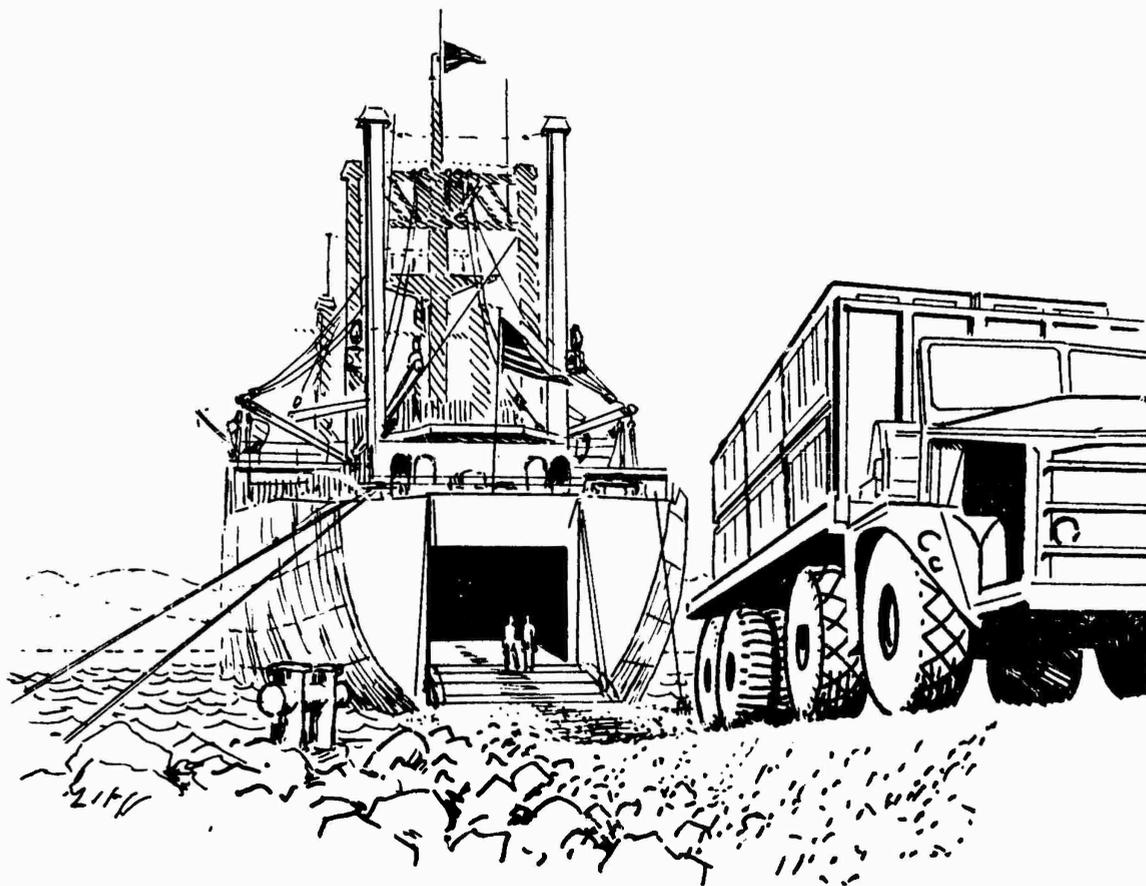


FIGURE 14. STERN LOADING VIEW OF RO/RO SHIP

(The terms Ro/Ro ship and containership are sometimes used interchangeably when actually there is no similarity between the two. A Ro/Rc ship loads and discharges vehicles in the same manner as a ferry boat carrying passenger automobiles and trucks. The term roll-on/roll-off accurately describes this principle of loading and discharge; the vehicles rolling on and off. A Ro/Ro ship usually carries its van-containers and highway trailers, as well as all other vehicles, on its wheels.)

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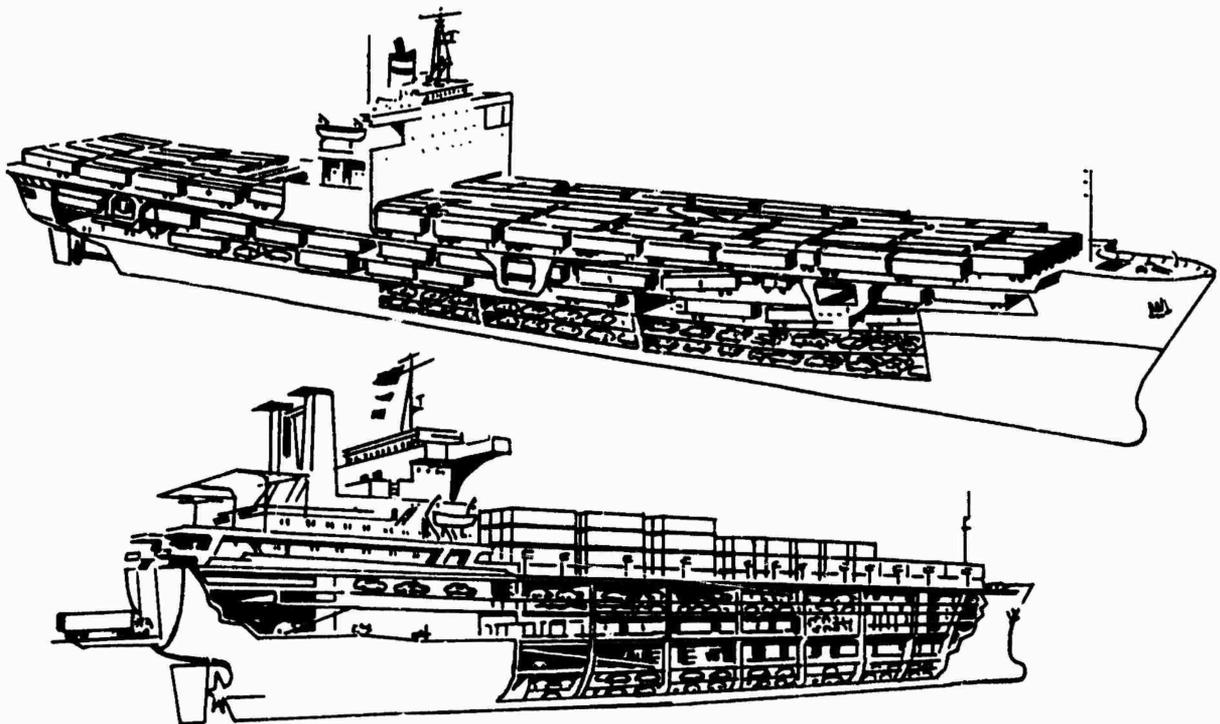


FIGURE 15. ROLL-ON/ROLL-OFF CONTAINER AND TRAILER SHIPS

(In addition to cell holds for the accommodation of van-containers, other distinctive means of handling cargo are present in the same hull, such as roll-on/roll-off and breakbulk cargo handling through side ports.)

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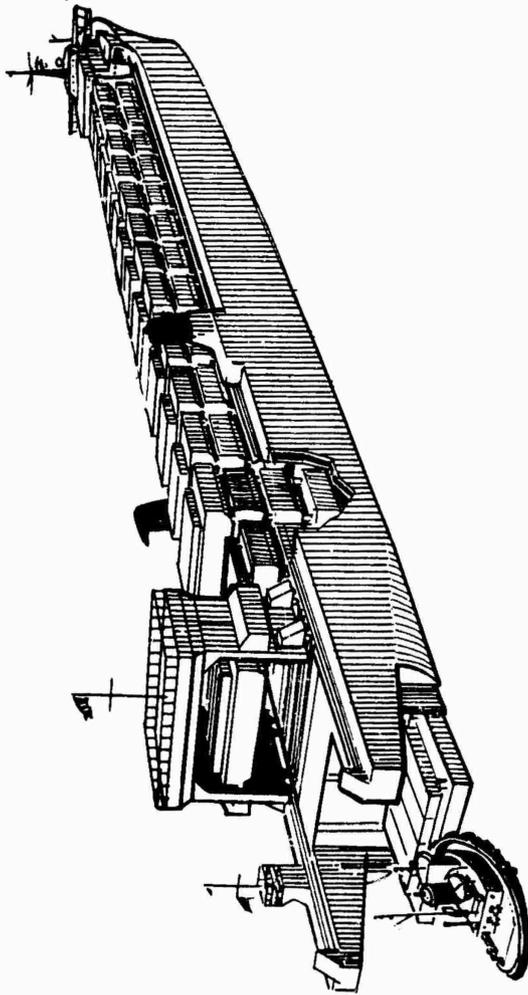


FIGURE 16. LASH SYSTEM

(In LASH system tug nudges loaded barge to stern of ship. Travelling crane then hoists it aboard and stacks it on hold or deck. At destination process works in reverse.)

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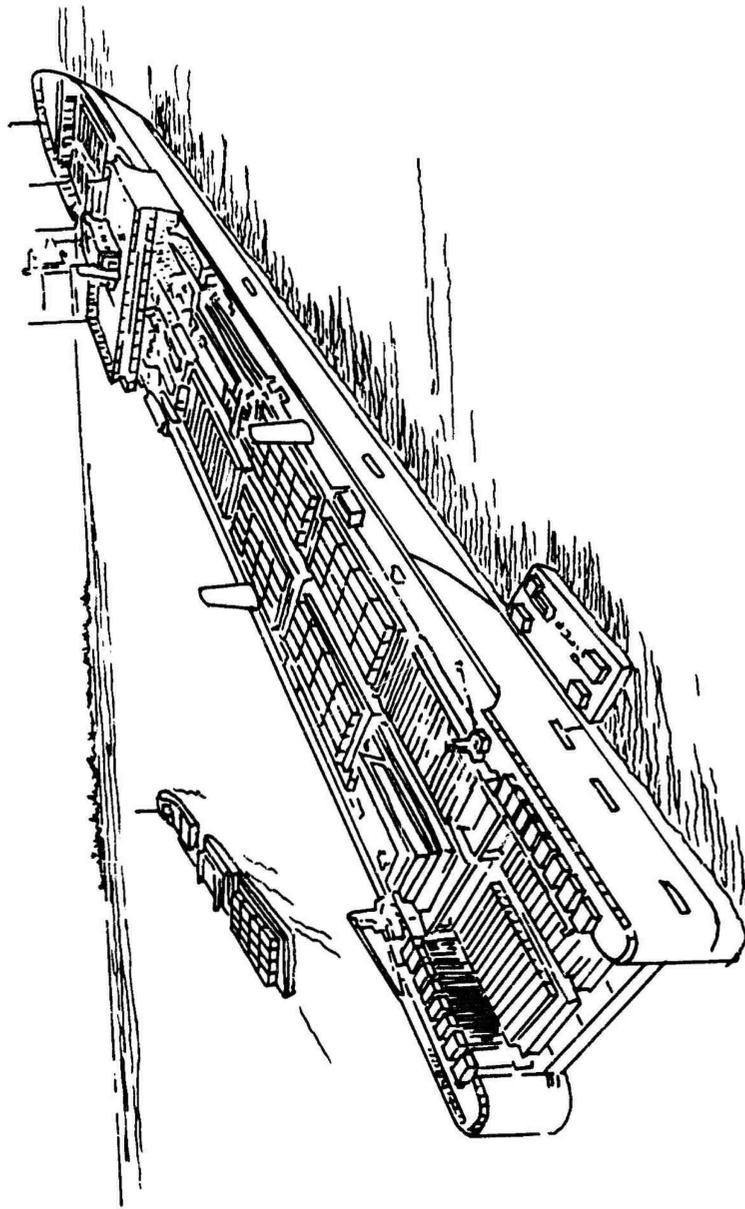


FIGURE 17. LIGHTER ABOARD SHIP (LASH) (SEABEE TYPE)

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(b) Barge-Carrying Ship. Three commercial steamship companies are planning for a different concept of containership, the barge-carriers. Two commercial ship lines have a total of 11 LASHs under construction, while another steamship company is building three SEABEEs. Whereas the LASH will transport barges designed specifically to fit its holds, the SEABEE has the potential of being an excellent multipurpose ship.¹² As indicated in the Transportation Monograph,¹³ the Commander, MSTs, has proposed that a military adaptation of the SEABEE be included in the FYDP because of its versatility as a transporter of containers and noncontainerizable military end items in the strategic mobility role and because of its intratheater capability, especially for operating in minor or undeveloped ports.

b. Discussion

(1) General. At present, DOD does not own any containerships, although MSTs has a contract for containership service. To take advantage of containerization requires the assurance that the system can meet the test of providing prompt and timely support to U. S. forces, both within CONUS and overseas, under three different sets of circumstances: peacetime support, unit deployments, and resupply of deployed forces.¹⁴ With respect to the sealift segment of container-oriented military logistic systems, there are two principal considerations under each of these circumstances:

- (a) the timely availability of adequate numbers and types of container ships and containers,
- (b) the capability to offload and clear containers rapidly through the destination port.

(2) Availability of Shipping

(a) Peacetime. Generally speaking, there should be no problem in shipping containers to U. S. forces overseas in the developed areas of the world, as regular container service to principal North Atlantic and Pacific Far East ports is now provided by several publicly held U. S. companies, five of whom have a substantial stake in containerized ship operations. There also is some service to major Mediterranean and Latin American ports. Most other areas of the world, however, do not now have regular container service and may not have for some years to come. As the numbers of containerships increase, the smaller and slower containerships will most likely be diverted from the major trade routes to areas of the world not now thought lucrative enough to warrant containership investment.¹⁵ Until regular commercial container service is established to such areas or DOD acquires or charters its own fleet of container ships, U. S. forces in such areas must continue to be supplied by air and by breakbulk or Ro/Ro sealift.

(b) Contingency Operations

1. Readiness for contingencies and the use of arrangements in peace that require little or no change in time of war have impacted on the method of procurement of commercial shipping by MSTs for augmentation of the nucleus fleet. For instance, efforts have been made to obtain commitments for support of contingencies by commercial shippers in the absence of ship requisitioning in a national emergency by assurance of military cargo in time of peace along the lines of the Civil Reserve Air Fleet (CRAF) program of the Air Force. This

¹²Col., Frank B. Case, "Contingencies, Containerships, and Lighterage," Army Logistician, Vol. 2, No. 2, March-April 1970, p. 18.

¹³See Transportation Monograph, Chapter III, JLRB Report.

¹⁴Joint Chiefs of Staff, Special Assistant for Strategic Mobility, op. cit., p. 38.

¹⁵Equity Research Associates, op. cit., p. 2.

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program known as RESPOND has been only partially implemented and has not been effective to date owing to the lack of agreement on shipping rates by commercial industry and the fact that RESPOND is limited to berth line operators. (See Chapter III, Transportation Monograph, for detailed discussion.) In addition the Maritime Administration (MARAD) has established a policy (January 1970) that all new or relatively new subsidized ships (built subsequent to 1950) now under charter to MSTs must be returned to commercial berth line service as soon as practicable without disrupting the operations of MSTs. Under the new policy MARAD will not approve new charters or extensions of existing charters to MSTs of any ships built since 1950 with Government subsidy assistance, unless it can be shown that such ships are urgently required by MSTs and/or are not needed for commercial operations. Because all subsidized operators must have MARAD clearance before making their ships available under RESPOND, it is unrealistic to count on RESPOND to produce many ships unless MARAD policy changes or unless wartime ship requisitioning authority is implemented.

2. If the container oriented merchant marine of the future is to be a military auxiliary, as in the past, the legislation which implements the President's new merchant marine program, which proposes a substantial building program of Government subsidies both to ship builders and to ship operators, must provide specifically for making available to DOD the necessary ships to augment the MSTs nucleus fleet under various contingency situations. Part of the problem undoubtedly is the political one of defining the various types of "contingency" situations under which DOD would have priority for merchant shipping. As discussed in Chapter II of the Transportation Monograph, MARAD has found that the overriding policy of the Congress, as reflected both in the Merchant Marine Act of 1936 and in the Merchant Ship Sale Act of 1946, is to provide U.S. flag merchant shipping "for the national defense." Yet current MARAD policy precludes MSTs from chartering the new ships. Unless the Congress stipulates the types of circumstances under which the DOD can preempt commercial shipping the military will be totally dependent on airlift plus such few ships as may be available in peacetime in the MSTs-controlled fleet.

3. Contingency operations create the widest fluctuations in cargo mix, ranging from some 90 percent unit equipment during the initial stages to a high percentage of general cargo during resupply operations. In the initial stage, the important factor is that unit equipment be discharged in an operational configuration so that the receiving units will be immediately combat capable.¹⁶ Although container support of U.S. forces in RVN provided valuable experience during the resupply phase, regular containership service was not instituted until after completion of the deployment phase.

4. Early in the Vietnam era, MSTs negotiated a contract to provide container service to SE Asia for military supplies. Vietnam ports then were congested and the contract proposal offered attractive possibilities for solution. Nevertheless, nearly a year elapsed before container service actually was in operation to any port in Vietnam. The delays involved then, within DOD, probably would not occur in the future. On the other hand, the special circumstances then existing were unique, since commercial ventures in containerization were just starting to grow. Under existing circumstances, it is highly doubtful that any U.S. commercial operator who has a major stake in container service competition would be willing to reorient his ships and containers and to establish the sophisticated terminal facilities and management information systems needed for efficient operation in an area of the world not on the major trade routes. To do so would be to lose his competitive advantages. Nor would it be in the overall economic interests of the United States to require him to do so. As discussed in the Transportation Monograph,¹⁷ and above current policy of MARAD is to withdraw the more modern U.S. flag ships from support of DOD so that they can accelerate the favorable trend toward U.S. commercial equality in world trade. Commercial ship operators are required to

¹⁶Joint Chiefs of Staff, Memorandum for the Assistant to the Secretary of Defense (Legislative Affairs), Subject: Information for the Special Committee on Sea Power (Military Use of Containerships), 24 July 1969, p. 4.

¹⁷Transportation Monograph, Chapter III, JLRB Report.

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perform the services for which they have made commitments unless the ships are removed from that service by the Government's emergency requisitioning procedures.

5. On the other hand, there is no present guarantee that commercial or military container resources will be readily available to support a future contingency of less than general war. Since World War II, military actions requiring logistic support have occurred in such locations as Lebanon, Berlin, Korea, Vietnam, and the Dominican Republic.

6. The resupply phase of a contingency operation of more than 6 months duration probably could be supported by a commercial container system once the necessary shore facilities were established. However, DOD would require a self-sustaining container-ship capability to meet surge and resupply requirements until the commercial service could be established.

7. In any future general war, it is envisioned that containership service will be available and mobilized for support of the war effort from the outset. A general war would involve the same allies whose ship owners provide the total free world capability for efficient transoceanic lift of containers. Logistic support of a general war probably would occur over the major trade routes, through the principal ports, and over the major highways, rail lines, and inland waterways — all of which are elements of the current commercial system.

(3) DOD-Assured Containerized Support. The Department of Defense needs to have an assured capability of providing containerized support in the initial phases of a future contingency situation in order to have necessary ships, containers, interface equipment, and management information systems under its own control. If the multipurpose ships (Figure 18) now in the Five Year Defense Program (FYDP) are approved, there would be an assured self-sustaining Ro/Ro containership capability, optimized for military rather than commercial operations, about 3 years from the time of Congressional authorization. But the numbers of such ships now in the FYDP is sufficient to deploy only the aircraft, unit equipment, and vehicles of one armored division or of one airborne and one airmobile division. Proposals of the Navy Department for military containerships for ammunition, and for barge carrying ships for service to minor ports, are not yet in the FYDP. In the interim, the only containership capability that might realistically be immediately available to support a contingency deployment would be those containerships under contract to MSTs.¹⁸

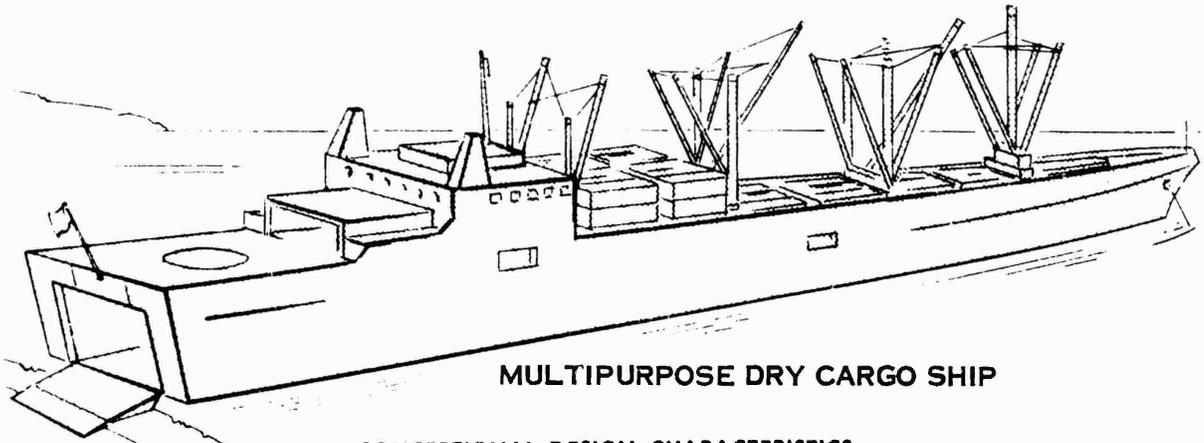
(4) Container Discharge Capability

(a) Nonself-sustaining Ships. Most commercial containerships now under construction are nonself-sustaining. These "superships" will require even more extensive terminal facilities for the transfer of containers from sea to land including additional shore-based cranes and larger marshalling areas. The capital cost of such ships creates pressures for high utilization and rapid ship turnaround. Shipboard cranes are not as fast as shore-based cranes; they require more maintenance and have space and weight characteristics that reduce the number of revenue-producing containers that may be carried.

(b) Self-sustaining Ships. There is a military requirement for self-sustaining containerships to be utilized when no shore-based container discharge capability exists. To ensure that the U. S. flag commercial fleet will continue to have a self-sustaining containership capability to meet military requirements, the "National Defense Features" should include, as a minimum, rails installed on the ships for rapid installation of shipboard cranes on commercial ships that are built with a construction subsidy or as otherwise arranged by DOD with the shipping industry. Under these conditions and in order to support the rapid conversion of these ships of self-sustaining capability, it may require DOD to procure and maintain in war reserve stocks a minimum number of gantry cranes to meet projected emergency requirements. Ideally, this war reserve capability should include gantry cranes that could be used interchangeably on rail equipped ship or piers. The MSTs nucleus fleet should include a self-sustaining

¹⁸ See Transportation Monograph, Chapter III, JLRB Report.

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CONCEPTUAL DESIGN CHARACTERISTICS

LENGTH OVERALL	648'	CARGO-HANDLING GEAR	14-20/T Booms
LENGTH (Between Perpendiculars)	582'	DRY CARGO CUBIC (Bale)	2-120/T Booms
BEAM	92'	SPEED:	1-10/T Booms
DEPTH	67'	Design	1,840,000 Cu. Ft.
DRAFT:		Full Load	21.6/K
Full Load	30.7'	CRUISING RADIUS	2:/K
Design	28'	(Nautical miles)	12,000
DISPLACEMENT:		DECK AREA—TOTAL	120,870 Sq. Ft.
Full Load	31,960/T	(Roll-On/Roll-Off)	
Design Load	26,940/T	CONTAINER CAPACITY	1,118
Light Ship	9,719/T	(8' x 8' x 20')	
CREW	35	PROPULSION:	
(Estimated MSTs Manning Scale.)		Shaft Horsepower	26,000
		Single Propeller	

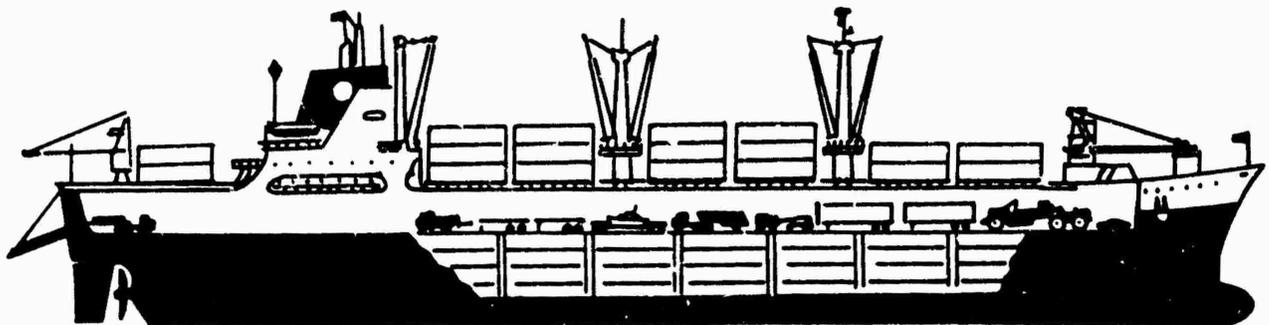


FIGURE 18. MULTIPURPOSE DRY CARGO AND ALL-PURPOSE SHIPS

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containership capability to offset the current trend in industry of having nonself-sustaining containerships constructed in foreign shipyards.

(5) Need for Military-Controlled Capability. In order that DOD may take maximum advantage of containerization for unit deployments, resupply of deployed forces, and peacetime support of installations in areas not served by commercial operators, two things must be done in the area of sealift capability:

(a) DOD must acquire its own fleet of self-sustaining ships, optimized for delivery of military items to ports that lack container offloading facilities. The program of 10 multipurpose ships now in the FYDP is a first step that requires Congressional approval for implementation.

(b) In any future contingency operation, the use of fixed-pier facilities may be denied or they may not exist. Therefore, a capability should be developed and in-being to discharge containers from self-sustaining containerships offshore onto lighterage for movement over-the-beach and by helicopter for movement beyond the beach area. Nonself-sustaining containerships will require additional equipment for discharge, such as a structurally strengthened mobile pier with installed gantry cranes or a floating crane.

6. OVERSEAS PORTS AND DISCHARGE POINTS

a. Terminal Design. Overall terminal design is at least partially dependent on the type of container service to be provided. Service exclusively by self-sustaining ship would enable the establishment of an austere container port operation requiring a deep-draft berth capable of accommodating the ship, sufficient marshalling area and chassis to support the staging and delivery pickup of containers inland, and a minimal facility to provide for the stuffing and unstuffing of containers. The requirement to receive nonself-sustaining containerships adds the need for some type of land-based or mobile lifting facilities to transfer the cargo from ship to pier. The other major factor in determining the design of the container port overseas is the technique to be used in the staging and marshalling of inbound and outbound trailers, i. e., single tier horizontal parking (on or off chassis) or the use of vertical staging in varying size stacks. Container operations may be established through either available fixed-port facilities or those provided through the use of mobile-port assets.

(1) Fixed Ports. Depending on the area of operations and enemy actions established commercial container facilities may or may not be available. Container facilities already established in an area of operations could possibly be leased or requisitioned to support military operations. In those fixed ports lacking an established facility, a minimum construction or rehabilitation program would be necessary to provide an austere container handling capability. This would include provision of some type of pier-to-ship lifting device, such as a gantry crane, to support nonself-sustaining containerships, marshalling area for staging containers, and a minimum covered storage area for stuffing retrograde containers and unstuffing containers for local small lot distribution in the theater.

(2) Mobile Ports. An austere container handling capability can be established in most areas of operation through the use of gantry crane equipped, reinforced De Long or other type mobile piers. Depending on the availability of the mobile piers and the provision of sufficient alongside water depths to accommodate the ships expected to provide the container service, this capability could be established in approximately 60 days.

b. Facility Requirements.

(1) Container stuffing and unstuffing facilities are required in the overseas terminal area to consolidate small-lot retrograde cargo for the container shipment to CONUS and to unstuff those containers necessary to permit onward movement of small-lot cargo to inland local consignees. This facility should be located at a sufficient distance from the pier area so as not to impede the smooth two-way flow of cargo between the ship and the marshalling area.

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(2) Sufficient marshalling areas should be provided in close proximity to the pier area to provide for the marshalling of containers awaiting loading aboard ship and for holding containers awaiting movement to inland consignees. Sufficient power outlets should be provided in the hardstand area to support the temporary holding of reefer containers. As was noted in the previous discussion of CONUS facilities the size of the marshalling area required will depend on the type of container staging techniques utilized.

c. Container Handling Equipment. The type container handling equipment required to support container operations in an overseas area is contingent upon the overall design of the system.

(1) Ship to Pier Transfer. When the service is provided exclusively by self-sustaining container ships, special equipment is not required by the port. However, when the port will be serviced by any mix of ships including nonself-sustaining container ships, then some type of lifting device must be provided for this purpose. The pier-mounted gantry crane such as that provided Cam Ranh Bay is the most desirable device available; however, less efficient heavy-lift house cranes and flating or shore-based mobile heavy-lift cranes provide the lift required.

(2) Terminal Operations. As was noted in the discussion of CONUS terminal operations, the types of equipment required are determined by the type of operations to be employed. Normally in an overseas theater the horizontal staging of containers on chassis would be employed. Although this technique requires the availability of a significant hardstand area and number chassis (see Figure 19), it does not require the sophisticated lifting and transfer devices required for vertical storage and staging. If the vertical staging concept is adopted, however, a family of lifting and transfer devices like those employed in many commercial operations would have to be procured and made available in the overseas terminal.

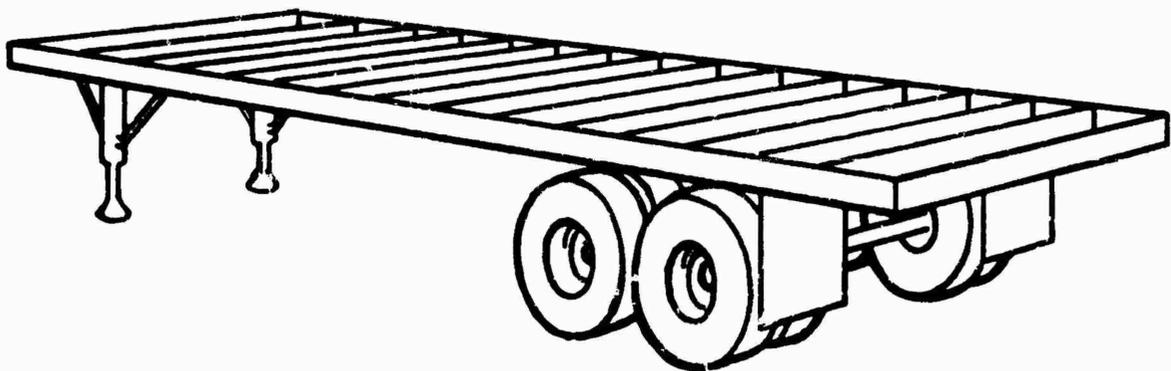


FIGURE 19. 40-FOOT CHASSIS WITH TANDEM BOGIES

(A semitrailer chassis with tie-down corner fittings for receiving and securing a van-container of matching size. The 20-foot chassis can have a single or tandem axle, depending on the load requirements. The 40-foot chassis is a tandem axle unit and is usually equipped with sufficient tie down fittings to enable it to accommodate either two 20-foot or one 40-foot van-container.)

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d. Logistics-Over-the-Shore (LOTS). Since intermodal containers have not been employed in complete LOTS operations, a full appreciation for the value and the problems associated with this type operation have not been developed. Full value of this service can be obtained only by adequate prior planning, prestocking of required equipments, and testing of the concepts and techniques through military exercises.

(1) Offshore Discharge Systems. LOTS operations require the presence of some sort of lifting device with which to offload the containerships in the stream. A self-sustaining containership could be used and probably would not require additional assistance to transfer the containers from the ship to the lighterage used. This concept, however, is still subject to confirmation by field test to determine if any additional equipment might be required. To fully examine this offshore container discharge capability a series of joint field tests need to be conducted to determine the feasibility of employing the following techniques:

(a) Offshore discharge of containers from nonself-sustaining ships onto lighterage by means of floating cranes or other mobile methods.

(b) Offshore discharge of containers from self-sustaining ships onto lighterage.

(c) Transport of containers by helicopters from self-sustaining ships to shore and inland movement.

To support the discharge of nonself-sustaining containerships, the U.S. Navy has developed a concept for a gantry ship that could be used to support container discharge and movement ashore. A conventional floating crane could also be used for stream discharge as well as discharge at the pier.

(2) Lighterage. Although most of the available lighterage and shallow-draft shipping could accommodate containers on chassis and discharge them in an Ro/Ro mode, this is a relatively inefficient means of moving containers. Space requirements for the chassis generally limit the number of containers that can be moved on small vessels. The most effective ship available during the Vietnam era to support this type of operation was the Barge Discharge Lighter (BDL) PAGE. But, even that ship was limited by the size of the deck usable for this purpose and the requirements to move containers in an Ro/Ro mode. A test conducted in January 1970 on the movement of ammunition to Vietnam by containers (Project TOCSA) proved the feasibility of moving containers on chassis via the BDL PAGE and the Alaska Barge and Transport Company (AB&T) ramp barge. These two craft were used to shuttle containers from Cam Ranh Bay to Qui Nhon in an Ro/Ro configuration. The use of this type lighterage would require the presence of a stock of chassis or the chassis would have to accompany the ship with a payload penalty or flat bed trailers incountry and a means of discharging the containership. In June 1969 AB&T developed plans for a 281-foot shallow-draft cargo vessel with a bow ramp and travelling bridge crane. This craft would be capable of carrying 90 - 35-foot containers in addition to 800,000 gallons of liquid cargo, 1,000 cubic feet of dry stores and 1,000 cubic feet of reefer stores. The use of this type craft would require the prepositioning of chassis or some other type of container-handling capability ashore to move the containers from the beach.

(3) Container handling equipment to support LOTS operations would have to possess the capability to operate in rough terrain and generally unimproved areas. If the containers are landed in the Ro/Ro configuration, limited lifting and transfer equipment would be required. However, if the containers are landed in a box configuration, in order to handle these containers ashore, there would be a requirement for the Services to obtain a family of equipment similar to that developed by commercial industry but with the added capability to operate over unimproved areas. Specific items of equipment that might be required include rough terrain straddle trucks and rough terrain container lifting devices, either cranes or forklifts, with a 50,000-pound capacity. Appropriate chassis as well as tractors would also be required for onward movement.

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(4) The heavy-lift helicopter delivery system (Figure 20) is a container discharge system based on the offshore discharge of self-sustaining containerships by heavy-lift helicopter. This concept negates the requirement for lighterage, improved beach areas, and sophisticated lifting devices. This method provides the capability to move containers directly from the ship to consignees or staging areas within a reasonable distance of the shore line. This provides the potential for avoiding congested ports as well as providing a service in areas devoid of water port facilities.

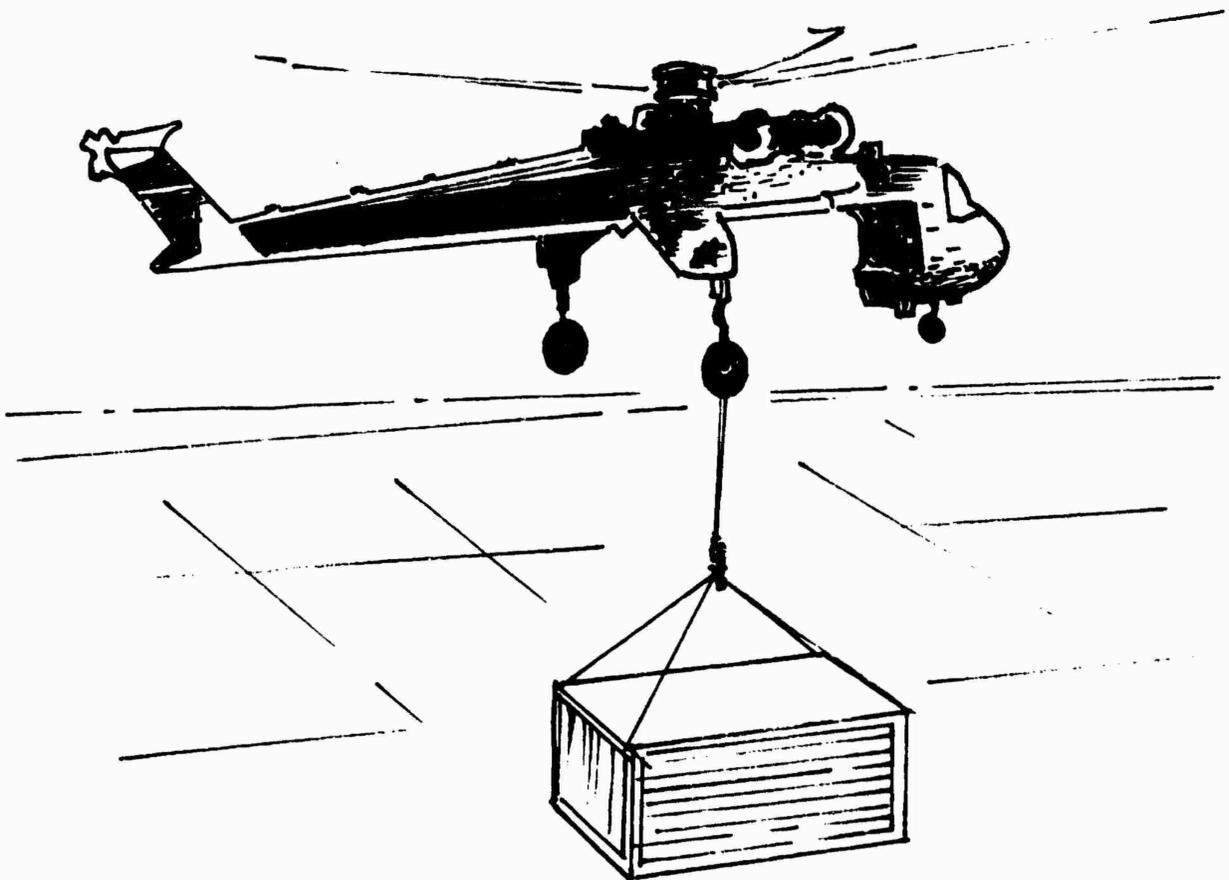


FIGURE 20. HELICOPTER MOVEMENT OF CONTAINER

CONTAINERIZATION

7. OVERSEAS PORT CLEARANCE. Overseas port clearance can be accomplished by any of several modes, but may well be limited by factors such as security, weather, terrain, and available lines of communication.

a. Highway. The port clearance of the commercial containers in Vietnam was primarily a function of the contractor within the free drayage range limit of the port. The contractor has his own tractors and chassis and maintained and controlled his own equipment. When it was necessary to deliver beyond those limits, the military M52 tractor proved to be generally inadequate for pulling the intermodal container, particularly through mountainous terrain.

b. Rail. The railroad was not used for the movement of containers in Vietnam because there was very little rail available; however, in future contingencies or when rail facilities are available, use of this mode should be considered. If container on flat car movements are planned, there will be a requirement for transfer capability from a ship, a truck, or chassis to the rail flat car and vice versa. This requirement should be incorporated in contingency plans.

c. Helicopter. Some experimentation has been done with direct movement of containers from a ship to an inland point with helicopters as an alternative to present methods of discharging containers from a ship to a pier for further inland movement by truck or rail. Container movement by helicopter seems particularly appropriate for use in early stages of an operation to prevent saturation of undeveloped ports. Current helicopters now in use have maximum lift capability of 10 to 12 short tons, but future heavy-lift helicopters are expected to have considerably increased capability.

d. Coastal and Inland Waterway. Vietnam experience has shown that in underdeveloped areas of the world there may be a considerable requirement for coastal and inland waterway transport capability, not only to provide intratheater distribution but also to perform port clearance. Such a requirement may well exist in future contingencies and the requirement will then be to transfer containers from deep-draft vessels into the smaller coastal or inland waterway vessels and craft for delivery to other ports. Though the major port clearance has been accomplished, the problem has been transferred on a smaller scale to other port areas. The clearance of these possibly less sophisticated port areas then must be provided for through roll-on/roll-off or as described previously for deep-draft ports.

8. OVERSEAS CONSIGNEES. In the development of military container-oriented logistic systems, there are potentially three separate echelons in overseas support to be considered. These are the overseas depot, the direct support units, and the using units.

a. Overseas Depots. These supply facilities can be expected to have essentially the capabilities that are found within CONUS facilities in many areas of the world, whereas in other areas they must be very austere with only open storage available during the early phases. The requirement for container handling capability, including container lift and transfer capacity, appropriate MHE container marshalling areas, the hardstand will vary accordingly. Also, supply operations should be oriented to through movement of van-sized or modular containers of supplies destined for either direct support units or to using units.

b. Direct Support Units. Capability of these units will be considerably less than found at the overseas depot. Capability to perform lift and transfer of the large container may well be limited to organic crane capability. To the extent it is desired to use the container for temporary storage, this lift capability as well as some type hardstand such as pierced steel or aluminum planks may be required. Sufficient capability should be planned to accommodate the smaller containers, either for temporary storage or, when feasible, for delivery on to the using units. Normal direct support could be provided through the use of modular or stowable containers.

c. Consuming Units. Requirements for container-handling capability will be very limited. Containerized supply would normally be received in either semitrailer configuration or in the smaller container modules capable of being handled by available manpower. If required, MHE would be provided by logistic support units for unstuffing the van containers or handling the small containers.

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d. Container Turnaround and Retrograde Operations. Normal movement of supplies in commercial containers will require the expeditious unloading and turnaround of containers by the consignees for return to the distribution system for continued use. Increased efficiency will result from the use of the empty container for return of repairables to CONUS or rear areas as retrograde cargo.

9. REQUIREMENTS FOR MILITARY-OWNED OR -CONTROLLED CONTAINERS

a. General

(1) A major increase in logistic economy and effectiveness through the exploitation of containerization requires the timely availability of the proper number and mix of intermodal containers and associated equipment. An important question is how these assets should be obtained. Both historically and during the Vietnam era, DOD has relied on the U.S. merchant marine to move more than 90 percent of DOD cargo, worldwide.¹⁹ The options for obtaining container systems assets include Government ownership, lease, or contract from commercial owners for exclusive military use through voluntary agreements or emergency requisition powers. Broadly stated, DOD policy is that if fairly priced commercial services can meet the military requirement, full use will be made of commercial resources. The military-owned resource requirement is basically driven by two considerations: first, the capability to immediately react in contingency operations until commercial resources can be applied to augment the military capability; and, second, to provide dedicated military resources that may be retained in-theater in contingency operations.

(2) The numbers and types of logistics support resources that the DOD should have under its immediate control in order to be responsive to the initiation of a contingency action is a function of the time required to obtain additional equipment or services. This lead time has two segments: first, the time necessary to process requests for procurement of equipment and to place contracts for service; and, second, the time necessary for commercial contractors and vendors to react to requirements placed on them. Certain major items of equipment are not commonly available on an immediate or off-the-shelf basis in commercial channels. For these items, the options are limited to direct military ownership or acceptance of the delay incurred through the long lead time required for manufacture. The only actual experience available concerning the lead time required for securing a container service in an undeveloped area is the contract negotiated for the movement of containerized cargo from CONUS to Vietnam. Although the lead time required for this contract was slightly over 1 year, it is considered reasonable that this could be reduced to less than 6 months in a similar future situation, provided that some proper planning was conducted in advance.

(3) Transportation requisitioning authority in time of war or national emergency is discussed in detail in the Transportation Monograph. None of these regulations or agreements, however, were executed in the Vietnam era, nor do they pertain to the requisitioning of containers. A recent study (Appendix A), based on Vietnam experience on actual tonnages for unit moves and support cargo during the buildup period, showed that about 38,000 standard 20-foot containers would be required to support a contingency force of 60,000 troops. The study was also based on a supply line of 7,200 nautical miles with conditions in-country related to the environment as experienced in Vietnam. No containers would be retrograded during the first 90 days, as they would be used for temporary storage and other purposes.

b. Container Standardization

(1) An integrated distribution system based on containers implies a universal interchange of these containers between different modes of transportation and among different carriers in each mode. This requires adoption of a container system standard — an agreed-on set of dimensions and other physical handling characteristics for containers — which everyone who wants to participate in the system must accept in order to optimize the use of the system.

¹⁹ Office of the Secretary of Defense (SA), Military Container Operations, 10 December 1969.

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(2) Standardization of container dimensions is a continuing issue among both U.S. and foreign industry interests. Efforts of the American National Standards Institute (ANSI) and of the International Standards Organization (ISO) have resulted in adoption of standards that prescribe intermodal containers should be 8 feet wide and 8 feet high, in nominal lengths of 5, 6 2/3, 10, 20, 30, and 40 feet. Since intermodal containers flow within highly integrated systems, their size vitally affects the vehicles, ships, and aircraft that transport them and the equipment that transfers them from one mode to another.

(3) Prior to the adoption of container standards in 1965, nationally and internationally (see Table 4), the pioneer containership operations began operating with non-standard containers and are continuing with their use. However, these pioneers and most other ocean carriers are moving toward standardization.

TABLE 4
CONTAINER SIZES AND STANDARDS

<u>Configuration</u>						
<u>Width</u>	<u>Height</u>	<u>Length</u>	<u>Gross Weight</u>		<u>Tare Weight*</u>	<u>Remarks</u>
88"		108"	10,000		355	463L Pallet
8'	8'	5'	10,000		N/A	
75"	82.5"	102"	10,500		1,500	CONEX
			USASI	SAE		
8'	8'	10'	22,400	12,500	2,000	
8'	8'	20'	44,800	25,000	3,500	
8'	8'	30'	56,000	35,000	4,300	
8'	8'	40'	67,200	45,000	5,000	
8'	8 1/2'	24'	46,200**		3,800 - 4,520	MATSON
8'	8 1/2'	35'	45,000**		N/A	SEALAND

*Tare weights vary widely with the type material used in construction of the container. (Average)

**These weights represent the unit capacity of the containers not the gross weight.

(4) The Department of Defense must concern itself with both domestic and international standards. As an example, for the optimum utilization of ships in an emergency in Europe, merchant ships of the North Atlantic Treaty Organization (NATO) nations probably would be pooled for control by a NATO Defense Shipping Authority. Noncompatible transportation and handling equipment and containers would greatly restrict the equipment pooling capabilities of such an operation and reduce the transportation system flexibility, efficiency, and usefulness.²⁰

²⁰ Arthur D. Little, Inc., Phase I Report, to American Merchant Marine Institutes, Inc., Standards for Cargo Containers, July 1967.

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10. CONCLUSIONS AND RECOMMENDATIONS

a. Conclusions

- (1) Based upon transportability, approximately two-thirds of all dry cargo moved by surface to Vietnam was containerizable. However, only a small percentage was moved in containers (paragraph 1a(2)).
- (2) Each Service, in accordance with its logistic support responsibility and operating command requirements, must determine what cargo should be containerized and how best to exploit the benefits of containerization to meet the particular needs of the Service (paragraph 1a(7)).
- (3) A family of Department of Defense standard modular containers would provide shippers maximum flexibility in containerizing less than van-sized container shipments for one consignee. The modular containers could be consolidated and shipped in a van-sized container to forward distribution points overseas. The overseas distribution point could forward the modular containers thereby improving the effectiveness and efficiency of overseas supply operations by maintaining the integrity of the shipment from source to final destination (paragraphs 1B(4) and 8).
- (4) The overseas component command must determine the consignees to receive and ship van-sized containers, and must advise shippers of any special requirements of the command such as palletizing all cargo and the requirement for or exclusion of overpack. All shippers must comply with procedures established with the overseas component command to facilitate and expedite the handling of cargo in a less sophisticated environment (paragraph 1d).
- (5) Procedures used for providing container movement rates and routing instructions to shippers are similar to those used to accommodate breakbulk shipments. These procedures do not provide for expeditious release and booking of containers or integrated routing by all transportation modes (paragraph 3b(1)).
- (6) To ensure responsiveness of container-oriented logistic systems, containers must be readily available for use by military shippers (paragraph 3b(2)).
- (7) The availability of a family of standardized containers, containerships, and handling equipment would greatly enhance the development of equipment pooling and interchange agreements. This availability of equipment pools and interchange capabilities would facilitate the availability and movement of containers and would assist the Services in the development of container-oriented logistic systems. Such a system would be capable of interfacing with international container systems (paragraphs 3b and 4b(2)).
- (8) The accelerating trend toward the replacement of commercial breakbulk ships with larger, deeper draft, nonself-sustaining containerships will force the adoption of a containerized Department of Defense supply and distribution system. On the other hand, the military has a requirement for medium-sized self-sustaining containerships to provide a capability to deploy and support forces in undeveloped areas that lack suitable container-handling facilities in the initial stages of a contingency (paragraphs 5a(1), 5a(2), 5b(4)(a), and 5b(4)(b)).
- (9) Maximum use of containers will require the prompt and adequate containership support of contingency operations. There is no present guarantee that commercial or military containerships will be readily available to support a future contingency of less than general war (paragraph 5b(2)(b)5).
- (10) Commercial container capability cannot be expected to be available to support contingency operations in underdeveloped areas for the first 3 to 6 months of the buildup period unless transportation requisitioning is authorized and provisions are made to include containers in this requisitioning authority (paragraph 5b(2)).

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(11) Under present plans, there will be no military containership capability until some 3 years after the 10 multipurpose ships in the Five Year Defense Program are authorized by Congress. These ships could deploy one armored division or one airborne and one airmobile division. The authority to obtain these ships under long-term charter arrangements would expedite this resource capability (paragraph 5b(3)).

(12) The provision for gantry crane rails as a National Defense Feature is required in the design characteristics of nonself-sustaining commercial ships built with Government subsidies, or as otherwise arranged, so that gantry cranes may be readily installed. This feature would enable quick conversion to a self-sustaining capability in the event commercial containership is required to support military requirements. A minimum number of interchangeable shipboard or pier gantry cranes should be maintained in war reserve stocks to meet emergency requirements (paragraph 5).

(13) Contingency plans must anticipate the requirement to support both emergency and sustained LOTS operations. In order to support this requirement, there is a need to jointly develop and test the capability for:

(a) Offshore discharge of containers from nonself-sustaining ships onto lighterage by means of floating cranes or other mobile methods.

(b) Offshore discharge of containers from self-sustaining ships onto lighterage.

(c) Transport of containers by helicopters from self-sustaining ships to shore and inland movement (paragraph 6d).

(14) With the increased use of large van-type containers, there will be a need to have sufficient heavy-duty tractor power available in the overseas area to support port operation and port clearance. Plans should also provide a capability for the inland delivery of containers via heavy-lift helicopters to consignees in remote or insecure areas (paragraphs 6 and 7).

(15) There is a need for the Department of Defense to have a military container capability to ensure support for contingency operations, to provide a limited peacetime capability to move containers to areas of the world not served by commercial container systems, and to complement the available commercial capability. This military capability should consist of sufficient military containerships, airlift, containers, and ancillary equipment (chassis and tractors), interface equipment, and discharge facilities and equipment (mobile floating cranes, mobile piers and their accessory equipment, gantry ships, and heavy-lift helicopters) to support the container systems designed (paragraphs 2, 5b(5)(a), 5b(5)(b), 7, 8, and 9).

(16) The Services must determine what special equipment is required to load, unload, and transfer from mode to mode the full range of loaded intermodal containers at military ocean terminals, including ammunition terminals, air terminals, overseas terminals, and shipping and receiving installations (paragraphs 2, 4d, 7a, 7c, and 8, and Section C, paragraph 5c).

b. Recommendations. The Board recommends that:

(CN-4) The Joint Chiefs of Staff determine the numbers and types of container-capable ships that must be in the Military Sea Transportation Service nucleus fleet in order to implement a containerization policy that will provide the resources necessary to meet requirements for peacetime support, and for contingency operations until such time as commercial containership service can be made available and operational in the contingency area (conclusions (9), (10), and (11)). Other recommendations that relate to this subject appear in the Transportation Monograph.

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(CN-5) The Secretary of Defense seek to have the legislation stemming from the President's Merchant Marine Program include positive provision for ensuring the responsiveness of modern U.S. flag containerships with gantry crane rails installed to meet military requirements under various conditions of emergency (conclusion (12)). Other recommendations that relate to this subject appear in the Transportation Monograph.

(CN-6) The Services jointly develop and test the capabilities and procedures for the conduct of logistics-over-the-shore container operations. Based on the results of these tests, the Services should establish their requirements for a family of containers, containerships, and container-handling equipment to support logistics-over-the-shore operations and should procure sufficient quantities of this equipment for ensured support of a contingency operation in under-developed areas (conclusion 13)).

(CN-7) The Secretary of Defense support the requirements of the Services to ensure the capability to support the port clearance and onward movement of containers in the area of operations. This capability should provide the necessary heavy equipment including interchangeable shipboard or pier-mounted gantry cranes, materials handling equipment, heavy-duty tractors, and heavy-lift helicopters (conclusions (14), (15), and (16)). Other recommendations that relate to this subject appear in the Transportation Monograph.

(CN-8) The Secretary of Defense support the military ocean terminal modernization including ammunition terminals (conclusions (15) and (16)). Other recommendations that relate to this subject appear in the Transportation Monograph.

SECTION C

LAND-AIR-LAND DISTRIBUTION SYSTEM

1. GENERAL

a. It is obvious that any total logistic system depends not only on land-sea-land transportation but also on exploitation of the special advantages of the land-air-land capabilities. Each Service must develop its own philosophy on the criteria that it will use in determining how much of its cargo will be moved by air. Each service philosophy on the extent that reliance will be placed on air transportation will be constrained primarily by the amount of airlift capability available and by considerations of the cost effectiveness of employing the air transportation system in moving selected items and commodities. Because the percentage of cargo tonnage moved by air will be relatively small in any major contingency, the utilization of air does not depend on the container-oriented logistic concept as does the surface segment.

b. This section will address those characteristics and areas considered peculiar to the land-air-land system. Areas such as documentation, development of commercial rate structures for movement of military cargo by commercial air, container standardization, container handling equipment at source and final destination, container turnaround and retrograde operations would be similar if not the same as previously discussed in connection with the land-water-land system.

2. BACKGROUND

a. The Air Force has been a leader in the use of the unitization principle to improve materials handling. In the middle 1950's it concluded that the larger transport aircraft must be loaded with large unit loads to keep ground times to a minimum. By the early 1960's the Air Force had developed the 463L materials handling system with the 9 by 7 1/2-ft. pallet as the heart of the system.²¹ (See Figure 21.) It is possible to "hook" these pallets together in "trains" two or more long to accommodate longer and heavier pieces of cargo. The present military airlift aircraft (C-130, C-141, and C-5) are equipped to carry these large unitized loads on trains of pallets and permit carrying the van-sized containers in aircraft. This system of unitizing air cargo on the 463L pallet was the primary method used for moving cargo in aircraft during the Vietnam era.

b. To date most of the commercial air cargo industry does not use the standard intermodal van-container because most of the present commercial air cargo aircraft are designed primarily to carry passengers and cannot accept containers large enough to be efficient in other modes of transportation. This situation will be altered with the introduction of the Boeing 747, the Lockheed 500, and other aircraft having similar payload capability. The president of one U. S. flag airline has been quoted as saying, "airlines will purchase 10,000 air cargo aluminum containers for use on Boeing 747 super jets, and this will be just the beginning. Hard on the heels of the B-747 will come the L-1011 and DC-10 as well as the L-500 all capable of carrying large amounts of cargo. All the containers purchased by the airlines will be interchangeable with land carriers. By 1975 there should be substantial potential for the door-to-door container concept."²²

²¹ M. F. Casey, MG, USAF, Director of Transportation, USAF, "Defense Transportation Journal," Outlook for Air Force Materials Handling and Packaging, January-February 1970.

²² "You Ought to Know", Railway Age, 16 December 1968, p. 32.

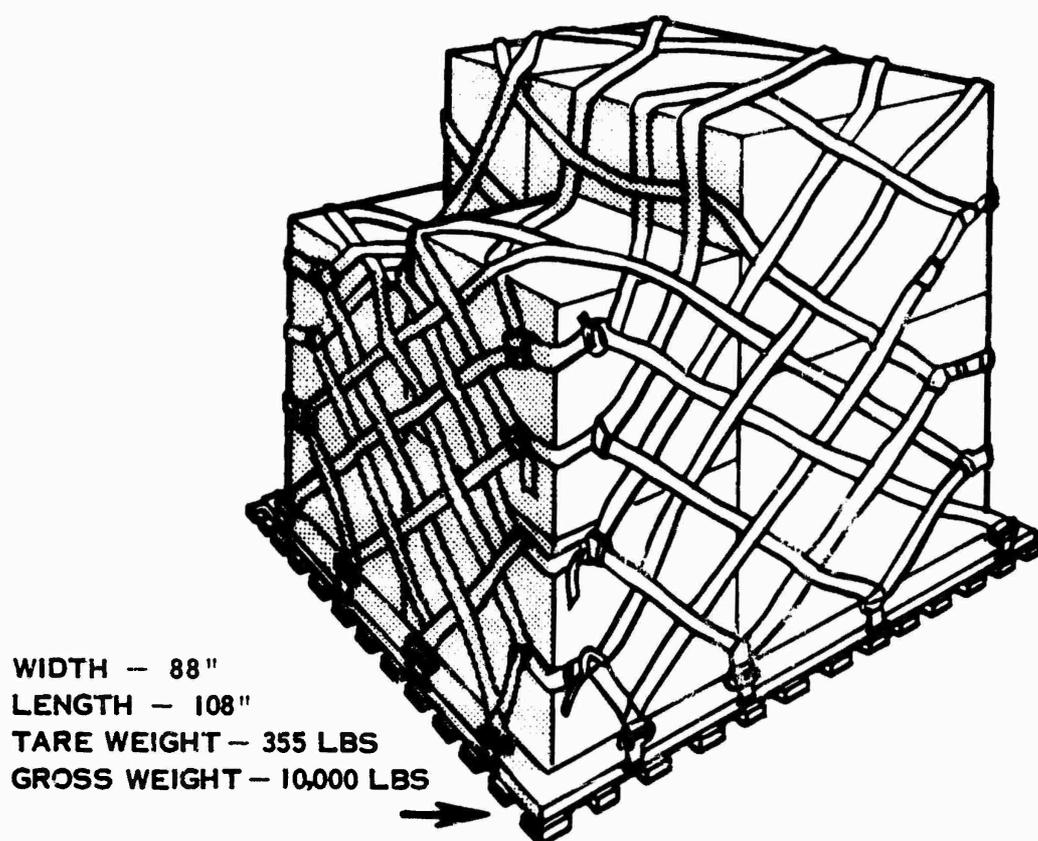


FIGURE 21. 463L PALLET WITH RESTRAINT NET

(A pallet used in the 463L system which has a rigid structural design consisting of 2 sheets of aluminum over a lightweight balsa core surrounded by a solid aluminum frame machined to fit into the guide rails and restraint locks attached to the floor of the aircraft. It can carry 10,000 lbs. of unitized cargo, which is covered with a plastic envelope and restrained by a set of specially constructed nylon web nets.)

c. At present the use of van-sized containers in the airlift system is limited as compared to their use in the land-water-land system. However, airline industry leadership in the development of containerized air cargo systems, with the newer generation "jumbo jets", has recently been concentrated toward the exploitation of air cargo movement in larger aircraft and larger containers.

d. Because of the cost of airlift and the limited airlift available as compared with other modes of transportation, tare weight (the weight of an empty container and/or pallet) has been a primary consideration in the development of air cargo movement equipment systems. The military efforts to date have been directed to the movement of air cargo on pallets rather

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than in intermodal containers. The military airlift capability does exist to move standard intermodal containers; however, wide scale use of intermodal containers within the air system must be carefully weighed against current air cargo movement systems now available that have been designed to take maximum advantage of available airlift.

3. SUPPLY DISTRIBUTION CONSIDERATIONS. The advantage to air transportation of moving unitized or containerized supplies are the improved loading and unloading of the aircraft and the reduction in aircraft ground or turnaround time. Other benefits are reduced terminal costs associated with fewer items to be handled, less damage, loss, pilferage, and fewer documentation problems. Most of the cargo traditionally considered for air shipment is susceptible to containerization. However, exploiting the quick response advantages of airlift tends to produce frequent deliveries in small quantities thereby curtailing the consolidation into large container loads. These conditions generate a requirement for shippers to consider not only the use of the standard intermodal containers but also the adoption of a depot-to-user or source-to-user unitization concept widely used at present. The shipper should balance his system to accomplish maximum consolidation of air cargo without defeating the advantage of speed of delivery and the requirements of the customer.

4. CONSOLIDATION AND MOVEMENT OF CARGO

a. Current Procedures

(1) Consolidation of export air cargo has mainly been performed at the MAC air terminals, where sophisticated handling and internal movement procedures have been developed to speed the movement through the terminal. Primary means of consolidation has been through the use of the 463L pallet system and its associated lift and conveyor systems. As resources have permitted, it has been possible to position the pallets at some inland depots permitting shipments to be palletized at origin. A restricting factor to consolidation at inland points has been the limited capability of consignors to hold cargo and still meet acceptable shipping time frames.

(2) It may well be that modular container development, as well as extension of MAC aerial ports inland, will enhance consolidation at origin. Increased use of airlift for routine shipments in Service distribution systems will also foster containerization at source.

(3) Movement clearance of air eligible export cargo, breakbulk or unitized, is accomplished by means of an offer, acceptance procedure. The military shipping activity, by means of advance documentation or other expeditious means of communication, requests air movement through designated shipper service control offices. These offices then function as the shipper service in submitting the airlift offer to the Military Airlift Clearance Authority (MACA), an office of the Military Traffic Management and Terminal Service, which in turn coordinates with the Military Airlift Command to program the cargo flow into the air terminals. In actuality the procedure functions on an exception basis, with the military shipper making the shipment to the aerial port of embarkation unless advised to hold the shipment by either the shipper service control office or the MACA.

(4) To date, cargo movement by military air has been on 463L pallets. What container movement has occurred has generally been restricted to CONEX or containers that have usually been physically placed on the 463L pallets for handling in the terminal and on the aircraft. The Air Force is investigating the possibility of developing a modular container (see Figure 22), and the Air Force is participating with other services in examining adaptations of the intermodal container to the air transportation system. The Society of Automotive Engineers has developed standards for land-air-land demountable containers that are compatible with the 463L system and come in lengths of 10, 20, 30, and 40 feet. (See Figure 23.) With the arrival of the jumbo jets, it is anticipated that there will be continuing efforts by aircraft and container manufacturers to design a land-air intermodal container. Therefore, intermodal movement procedures will be required to encompass both military and commercial air transport systems.

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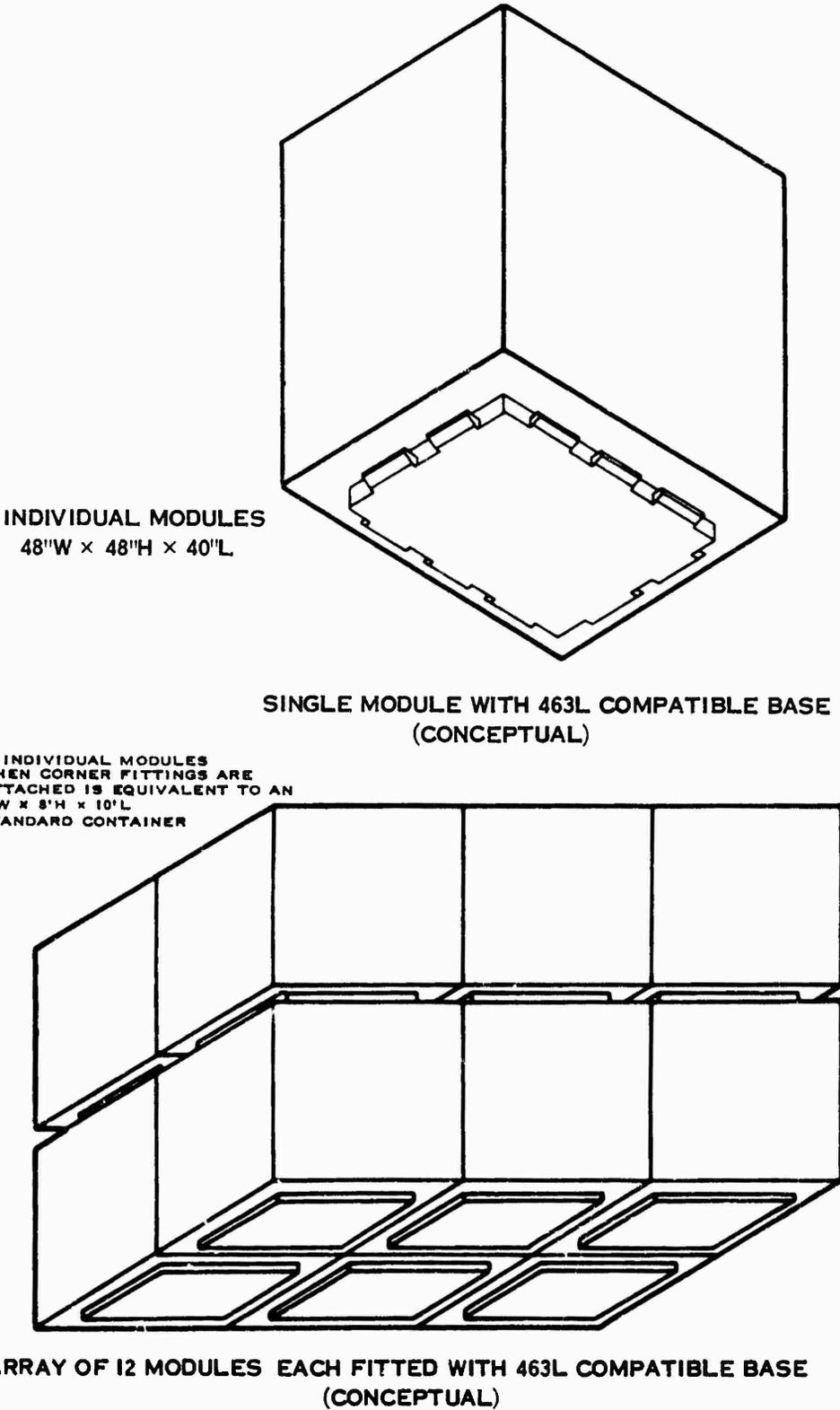


FIGURE 22. 463L PALLET WITH MODULES

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SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)
CONTAINERS ARE 8' WIDE, 8' HIGH, AND
IN LENGTHS OF 10', 20', 30', AND 40'

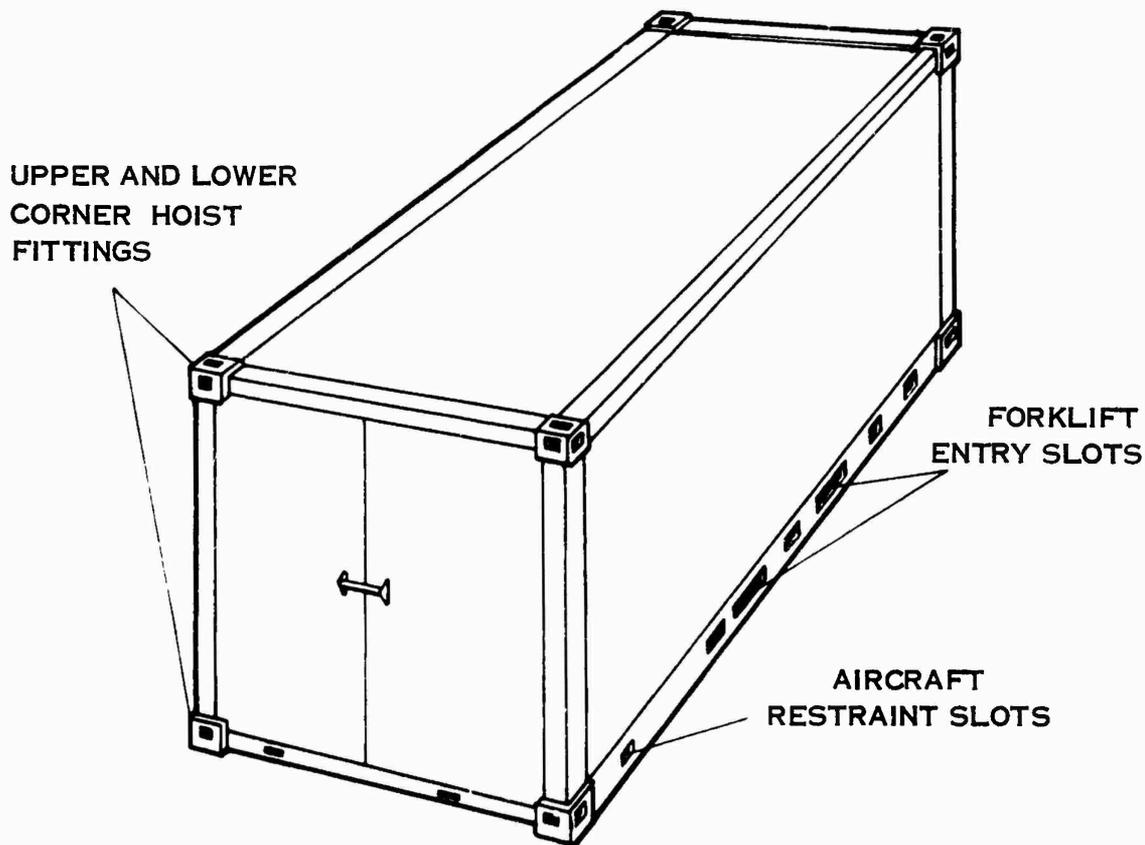


FIGURE 23. SAE CONTAINER, TYPE IID

5. CONUS AND OVERSEAS AIR TERMINALS

a. Facility Requirements and Terminal Design

(1) Five automated terminals were constructed in CONUS to support the 463L system. These terminals were oriented to the sorting and processing of small cargo shipments into pallet-size loads and not with the handling of containers.

(2) As a family of land-air-land containers is developed which can be made available to the shippers, the flow of containerized cargo into the air terminals in CONUS will increase. As this increase takes place, the requirement for sophisticated terminal facilities in CONUS to receive and process small-lot shipments should decrease. As this trend evolves there will be an increased requirement for the terminal facility to be more oriented to stage container and pallet loads in plane load lots as opposed to a large requirement for facilities oriented to the stuffing and unstuffing of containers or the building and breakdown of pallet loads.

(3) Facilities in the overseas area should be primarily oriented toward the transfer of unitized and container loads of cargo from the aircraft to the mode of transportation

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selected for onward movement to the consignee. Limited covered facilities will be required to provide for the unstuffing of containers for further distribution of small lot cargo and the unitizing of retrograde breakbulk cargo moved into the terminal.

(4) These facilities should be in reasonable proximity to the aircraft loading areas to support the rapid turnaround of transport aircraft and at the same time avoiding congestion around the runway and taxi areas.

c. Container-Handling Equipment

(1) The various size-K loaders (25,000-, 40,000-, and 55,000-pound capacity), which are an integral part of the 463L system, provide the air terminals with the capability to handle containers whose gross weight falls within the acceptable limits of the equipment, the 40,000- and 55,000-pound loaders could handle containers as large as 35 and 40 feet in length provided they are secured to a train of 463L pallets. In the future there will be a requirement to handle the broad range of containers moving through the DOD transportation system to include the van size container. The CONUS and overseas air terminals should be equipped with appropriate type loaders and other handling gear to ensure the rapid turnaround of transport aircraft and expeditious handling of containers within the terminal area. At smaller, forward area airports, the MHE required to handle the unitized loads on pallets or smaller modular containers must be capable of maneuvering over rough and unimproved surfaces and standardized to facilitate spare parts replacement for maximum incommission rates.

SECTION D

SYSTEMS DEVELOPMENT RESPONSIBILITIES

1. BACKGROUND

a. As reflected in this monograph, containerization impacts on many areas within supply and transportation. To meet the challenge of the innovation of containerization and to develop logistic systems oriented to containerization, it is essential that concepts be developed which take into account all facets of the different logistic systems and requirements of the Services.

b. To date the thrust in containerization has resulted primarily from transportation-oriented developments such as the introduction of new types of transportation equipment, ships, and vehicles.

2. DISCUSSION

a. If the total benefits of containerization are to be exploited throughout the entire DOD logistic system there is a major requirement to develop supply distribution and transportation concepts oriented toward maximum containerization. In order to develop these concepts and systems it is essential to recognize the requirement and then to organize for their development.

b. The requirement appears axiomatic but, to meet the requirement to formalize the concepts, for systems development, there is one basic principle: It is fundamental that the compelling force behind development of containerization must be the logistic users of containers—not the operators. The operators, MSTS, MTMTS, and MAC, must adjust their transportation services to accommodate the system concepts of the users.

c. To accomplish the task there is a need for the users to:

(1) Develop basic doctrinal concepts, systems design, and operating procedures for exploiting use of van-sized containers and modules in that portion of logistic operations dependent on a land-water-land transportation system.

(2) Outline and monitor such feasibility tests and development as may be necessary.

(3) Standardize mechanical interfaces between containers, modules, transportation equipments, and materials handling equipment.

(4) Provide a basis for development of service-related requirements.

(5) Define the impacts on and special requirements related to depots and single manager transportation agencies.

(6) Stated another way, basic questions to be answered are these:

(a) What container distribution systems should be established and what controls are needed for these systems?

(b) What organizations and equipment are required for container operations?

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(c) Considering total systems, what is the most effective way to unload the containerhips in over-the-shore operations in underdeveloped countries?

(d) How many Government-owned containers should be purchased and how will they be used?

(e) What changes in operating procedures, force structure, and training will be required to implement a military container system?

(f) What will be the cost of implementing container-oriented logistic systems and what savings can be realized through their adoption?

d. An analysis of surface movements during the Vietnam era, as shown in Table 5, indicates that the Army has consistently been the predominant shipper of military cargo by common-user water transportation assets on a worldwide basis. A review of air movements during the same period indicates that although the Air Force was the predominant shipper of cargo by common-user airlift on a worldwide basis in 1965 and 1966, the Army became the major air shipper to Vietnam in 1966 and by 1967 had succeeded the Air Force as the major shipper by airlift worldwide.

TABLE 5
CARGO MOVED BY COMMON-SERVICE
SEALIFT AND AIRLIFT

(Percentage of Total Tons Moved)

CONUS to RVN Movements

<u>Year</u>	<u>Water (Sealift)</u>				<u>Air</u>		
	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>	<u>Other</u>	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>
1965	N/A	N/A	N/A	N/A	43	9	48
1966	65	26	8	1	51	12	37
1967	73	14	10	3	66	16	18
1968	68	19	10	3	68	18	14

Worldwide Movements

<u>Year</u>	<u>Water (Sealift)</u>			<u>Air</u>		
	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>
1965	59	21	20	25	14	61
1966	59	24	17	30	17	53
1967	64	19	17	40	21	39
1968	65	19	16	42	20	38

Source: Transportation Data Base, pp. 10, 19, and 28.

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e. The Army is the dominant Service with respect to cargo shipped and logistic support to sustained, land-based combat in overseas areas. Therefore, the Department of the Army would have a primary interest in the establishment of a joint effort to develop the concept and systems discussed in paragraph 5 concerning a land-water-land container system.

f. Because of the Air Force's worldwide aerial port loading and discharge responsibilities and because its resupply concepts are more closely oriented to airlift support than are the other Services, the Department of the Air Force has a primary interest in the establishment of a joint effort to develop the concept and systems previously discussed concerning a land-air-land container system.

g. To develop the land-water-land and land-air-land systems the Army and Air Force respectively could each be assigned the task to lead and coordinate joint efforts to establish a wartime container systems capability oriented toward minimizing requirements for overseas facilities and manpower and tailored toward the harsh environment of a combat theater. Elements to be addressed include:

- (1) Capability to unload containerships in an over-the-beach operation.
- (2) Special equipment requirements.
- (3) Organizational implications.
- (4) Use of containers for temporary storage.
- (5) Simplification of supply and transportation documentation.
- (6) Orientation of supply documentation toward compatibility with overseas inventory and locator records.
- (7) Source to forward area delivery concepts and procedures.
- (8) Consolidation points in CONUS and overseas as necessary.
- (9) Basis for establishing requirements for Government ownership of containers.

h. The joint efforts led by the Department of the Army and Department of the Air Force directed to this task could provide:

- (1) A means of obtaining authoritative decisions.
- (2) An assurance that the user concepts and other interests of all Services are given full consideration.

i. DOD Directive 5126.43²³ provides for the Logistics Systems Policy Committee to direct the development, maintenance, and coordination of the Logistics Systems Plan (LOGPLAN) also established as policy, the following procedures.

"Development of subordinate plans for attainment of approved LOGPLAN objectives will be effected by task order assignment. Task orders may be assigned to joint OSD/Service/Agency groups, to a single lead Service/Agency or by utilization of contractor services."

²³Department of Defense Directive 5126.43, DOD Logistics System Planning, 26 March 1970.

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j. Paragraph 3 of Attachment 3 to Minutes of the DOD Logistics Systems Policy Council #3 of 14 March 1970 provides for expansion of containerization technique under the auspices of the Logistical Systems Policy Committee. The applicable portion is quoted below:

"III Objectives

A. Seek ways and means to reduce inventory investment and concurrently increase responsiveness and effectiveness of "front-line" support consideration will be given to:

1. Direct delivery concepts and systems to include the need for high speed direct support from supplier to customer, and the expansion of containerization techniques."

k. The foregoing procedures provide a logical basis for assignment of the necessary tasks to carry out the joint efforts required to develop the container-oriented logistic systems.

3. CONCLUSIONS AND RECOMMENDATIONS

a. Conclusions

(1) There is an immediate need to task two joint Service efforts to lead and coordinate a program to:

(a) Develop basic doctrinal concepts, systems design and operating procedures for exploiting use of van-sized containers and modules in that portion of logistic operations dependent upon a:

1. Land-water-land transportation

2. Land-air-land transportation system

(b) Outline and monitor such feasibility tests and development as may be necessary.

(c) Standardize mechanical interfaces between containers, modules, transportation equipments and material handling equipment.

(d) Provide a basis for development of service-related requirements.

(e) Define the impacts on and special requirements related to depots and single manager transportation agencies.

(f) Determine how many Government-owned containers should be purchased and how they should be used.

(g) Determine changes in operating procedures, force structure and training needed to implement a military container system (Section D).

(2) Since the Army is the dominant Service with respect to logistic support to sustained land-based combat in overseas areas and operates the terminals worldwide, the Department of the Army is in the best position to lead and coordinate the joint Service effort on the land-water-land program. Likewise, since the Air Force has worldwide air terminal loading and discharge responsibilities for airlifted supplies and also because the Air Force resupply concepts are more closely oriented to airlift support than are the other Services, the Department of the Air Force is in the best position to lead and coordinate the joint Service efforts on the land-air-land program. The operators - Military Traffic Management and Terminal Service, Military Sea Transportation Service, and Military Airlift Command - must adjust their transportation services to accommodate the system concepts of the users, but full coordination between the Services, DSA and the single manager operating agencies is necessary to ensure that users concepts are operationally supportable and economical (Section D).

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(3) The compelling force behind development of logistics systems based upon containerization must be the logistic users of containers. Logistic users must, of course, develop systems in coordination with the operators. Therefore, each individual Service will need to tailor the logistic systems peculiar to that Service to the use of containers and to adopt those systems to exploit the advantages of containers (Section D).

(4) The Logistics System Policy Committee is the logical body to sponsor and review the development of container-oriented logistics systems as set forth above. The main thrust of the joint effort should be action oriented, as opposed to study oriented, taking full advantage of all past and ongoing Service or agency studies and programs (Section D).

b. Recommendation: The Board recommends that:

(CN-9) The Logistic System Policy Committee task the Departments of the Army and the Air Force to lead jointly staffed efforts to coordinate the development of land-water-land and land-air-land container-oriented logistic systems, respectively. The thrust of these efforts should stress the "how" and not the "whys" of containerization, and be directed toward early development of container-oriented logistic systems. In order to ensure the incorporation of all relevant considerations and maximize the probability of prompt implementation of recommendations, the senior Service representatives engaged in the joint efforts should be responsible to their respective Services as well as to the Director of the joint effort (conclusion (1) through (3)).

CHAPTER IV
SUMMARY

CHAPTER IV SUMMARY

1. OVERVIEW

a. The Joint Logistics Review Board study and analysis has clearly and conclusively established that containerization represents a key to major improvements in the efficiency and economy of logistic support to combat forces. Hundreds of millions of direct dollar savings in operating costs and in cost avoidance can be realized in a contingency like Vietnam by exploiting the potential of containerization to improve supply, distribution, and transportation operation. The logistic system efficiencies reach well beyond the basic movement economies of containerization.

b. The advantages of containerization are becoming widely recognized in commercial circles. Commercial operators, driven by the overwhelming cost advantages, are moving rapidly to fully exploit the new technology. In less than a decade, containerization has become the single most important force in general cargo handling and several billion dollars have been invested by the ocean shipping industry in container facilities and equipment in the short period since 1966.

c. United States shippers first perceived the economic advantages and have thus led the container revolution; foreign ship owners have been forced to follow suit. On 30 June 1969 there were 79 U.S. flag containerships and an additional 103 ships with partial capacity for containers. At present approximately 120 containerships and 460 breakbulk ships are in the U.S. merchant marine. By 1980, this fleet is expected to number 220 containerships and 190 breakbulk ships. Although fewer ships will be available in 1980, the total U.S. merchant marine sealift capability will be about the same because the ships will be more productive.

d. The Department of Defense has always been, and remains today, largely dependent on the commercial ocean carriers for movement of military cargo in peacetime as well as wartime. The Department of Defense policy, broadly stated, is that if fairly priced commercial services can meet the military requirement, full use will be made of commercial resources. Since commercial operators are converting from breakbulk ships to container ships, it is clear that in the future the bulk of maritime shipping furnished by the merchant marine to the Department of Defense will consist of containerized ships.

e. The Military Sea Transportation Service nucleus fleet is needed for immediate reaction capability for military contingency operations and for the flexibility associated with peacetime ocean transportation support of the Armed Forces including specialized operations support requirements. Currently there are no containerships in the Military Sea Transportation Service nucleus fleet; consequently, there is an immediate requirement to modernize the fleet.

f. Full exploitation of containerization throughout the Department of Defense offers major challenges and rewards. The challenges are associated with programming and managing the resources toward the end of optimizing military logistic operations for the future. The rewards involve manifold improvements in the economy, efficiency, and responsiveness of future logistic operations of a yet to be determined but certainly substantive magnitude. The comprehensive reassessments of supply, transportation, and logistic systems doctrine of the Services associated with containerization are not unlike the perturbations induced by containerization in the commercial distribution industry. The Department of Defense challenge of the moment is "how" as opposed to "why".

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g. The DOD and the Services must move to exploit rather than react to the potentials of containerization. The economies to be derived through containerization in the military services' logistic systems leads to an urgent requirement for a bold commitment toward container-oriented military logistic systems.

2. USE OF CONTAINERS AND ITS ECONOMIC IMPLICATIONS

a. Lessons Learned

(1) Containerization is one of the highest potential payoff areas for reducing logistic cost in peacetime and in future emergency operations by increasing the efficiency of supply, distribution, and transportation operations.

(2) Vietnam experience clearly demonstrated the advantage of containerized shipments over breakbulk shipments through savings in costs, manpower, and time resulting from reductions in cargo handling, pipeline investment, port facilities, storage facilities, shipping, and loss damage and pilferage.

(3) Analysis of shipments in support of the Vietnam operation proved that except for a relatively small amount of outsized cargo, practically all DOD general cargo is containerizable either in CONEX-size or van-type containers.

(4) Containers were an integral part of a special endeavor to provide Cam Ranh Bay with an enhanced capability when the decision was reached to make that installation a major U.S. Army supply base. As in most locations in Vietnam, the construction of depot facilities did not keep pace with the influx of supplies and equipment. It was estimated in January 1966 that by the end of June 1966 the Cam Ranh Bay depot would be supporting a force of 95,000 men. In an effort to overcome the lack of facilities, the Army Materiel Command prepared a pre-packaged depot, in effect, containing a 60-day stockage level of repair parts for all units supported by the depot at Cam Ranh Bay. When completed, the entire package of about 53,000 line items was contained in 70 military van semitrailers and 437 binned CONEX containers— together with a library of manuals, stock records, locator cards, and other documentation. This concept represented container-oriented logistics in a sophisticated form. The movement of a section of a depot intact from the United States to Vietnam was a good example of the integration of supply and transportation systems. The project packages arrived at Cam Ranh Bay on 21 May 1966, and a total of 13,538 material release orders were issued during the first 10 days of operation with only 26 warehouse denials (less than 0.2 percent).

(5) Ammunition has also been successfully handled in containership service. During December 1969 and January 1970, a test was conducted of the feasibility of shipping ammunition from the United States to Vietnam utilizing containership service. A self-sustaining containership was used in the test to move 226 containers of ammunition from the United States to Cam Ranh Bay. Some of the containers were unloaded in the ammunition depot at Cam Ranh Bay, whereas others were transhipped on lighterage to Qui Nhon and on to forward supply points. The test was such a complete success that the 1st Logistical Command recommended the initiation of regularly scheduled ammunition resupply in containerships to reduce order and ship time with attendant savings in pipeline inventory. In addition, the 1st Logistical Command indicated that such action could lead to the phasing down of the ammunition depot at Qui Nhon.

(6) Containerization offers many advantages during the early buildup phase of contingency operations similar to Vietnam in transportation and for other purposes. These include but are not limited to the following:

- (a) Prestockage and movement of unit equipment
- (b) Prebinned stocks to include pre-positioned war reserves

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- (c) Temporary storage
- (d) Facilities such as shelters, shops, housing, and communication and command centers.

b. Recommendations

(CN-1) Based on the sound economic case for containerization and the uniformly favorable response to Vietnam experience, the Department of Defense adopt a policy that all oceangoing military cargo that will fit in a container will move in a container, with deviations to this policy treated as clear-cut exceptions.

(CN-2) The military departments exploit the use of containers by maximizing the use of containers for purposes to include:

- (1) Moving unit equipment to support deployments.
- (2) Pre-binning of stocks when desirable to facilitate in-theater logistic operations.
- (3) General cargo distribution.
- (4) Temporary storage.

3. CONTAINER-ORIENTED LOGISTIC SYSTEMS

a. Lessons Learned

(1) Experience with large intermodal containers in Vietnam clearly indicates that full exploitation can have as revolutionary an impact on military shore-based logistics as it has had on commercial shipping. Among the major logistic problems encountered in moving supplies to Vietnam were the following:

- (a) Lack of personnel, equipment, and facilities to discharge ships.
- (b) Lack of depot facilities and experienced personnel to warehouse supplies.
- (c) Loss, damage, and theft of cargo and deterioration of supplies stored in the open.
- (d) Inability to identify cargo received in depots.
- (e) Delays in translating cargo documentation into inventory records.
- (f) Inability to effectively ship directly from CONUS source to major user without passing through intermediate theater and in-country supply echelons.

(2) The use of containers proved that many problems can be significantly alleviated by proper systems application of containerization. For example:

(a) Containerships can be discharged 7 to 10 times faster than breakbulk ships, with fewer personnel on each shift. Drastic reduction in berthing space and in port operating personnel result.

(b) The practicality of operating directly out of containers prebinned in the United States was demonstrated at Cam Ranh Bay.

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(c) All recipients of containerized cargo were enthusiastic about reduction in loss and damage — particularly for ammunition, perishable cargo, and Post Exchange supplies.

(d) Because cargo is moved intact in a container from the CONUS to the depot or directly to a forward unit, problems in sorting and identifying cargoes are minimized.

(e) The Cam Ranh Bay operation proved that prepunching cards in the United States and covering the material in a container can speed up the documentation of assets and reduce errors in inventory and locator records.

(f) The shipment of containerized ammunition loaded inland in the CONUS was shipped directly to forward ammunition supply points. There was no difficulty in unloading operations and the cargo was in better overall condition than any ammunition previously received in Vietnam.

(3) Vietnam experience with the CONEX container fleet and the larger, commercially provided, van-sized container capabilities clearly indicate vast potential for improved logistic operations. However, from a position of leadership and dominance in containerization with the CONEX experience, the Services have fallen behind commercial industry in containerization and its systems applications because of the continued influence of breakbulk supply and transportation systems. To catch up, experience to date indicates that significant changes in concepts and procedures will be required.

(4) The Vietnam conflict again emphasized that the DOD may be called on to conduct extensive military operations without the exercise of powers required to requisition ships and supporting facilities. Consequently, the DOD must acquire a capability to provide containerships, supporting facilities, and equipment to support wartime operations until commercial service can be made available through contractual arrangements. This period could range up to 180 days.

(5) In Vietnam both self-sustaining and nonself-sustaining containership discharge was limited to the use of fixed-pier facilities. During the early phases of future contingency operations the military must have the capability to off load container ships in areas where fixed facilities do not exist. Therefore, to provide for using containers where fixed piers are not available, there is a requirement to jointly develop and test military capability for:

(a) Offshore discharge of containers from nonself-sustaining ships onto lighterage by means of a floating crane.

(b) Offshore discharge of containers from self-sustaining ships onto lighterage.

(c) Transport of containers by helicopters from self-sustaining ships to inland points.

(6) Containerization during the Vietnam era resulted primarily from transportation-oriented developments such as the introduction of new types of transportation equipment, ships, and vehicles. If the total benefits of containerization are to be exploited throughout the entire Department of Defense logistic system there is an urgent requirement to develop supply distribution and transportation concepts oriented toward maximum containerization. In order to develop these concepts and systems it is essential to recognize the requirement and then to organize for their development.

(7) The requirement for increased military reliance on containerization is axiomatic.

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(8) It is fundamental that the compelling force behind development of containerization must be the logistic users of containers. Integrated supply, distribution, and transportation concepts oriented toward maximum containerization must be developed by the users in coordination with the operators MSTS, MTMTS, and MAC. The operators must in so far as practicable adjust their transportation services to accommodate the system logistic concepts of the using Services.

(9) Container-oriented logistic support systems can be broken down into two basic subsystems, and commercial enterprise is directed toward developing these subsystems. These subsystems relate to land-water-land movement of containers and to land-air-land movement of containers. Because the Army sponsors two-thirds of the cargo moving overseas by surface means, operates ocean terminals both in the United States and overseas, and must clear cargo from these ports, it has the predominant interest in the land-water-land subsystem. It would be logical, therefore, to task Army to lead a jointly staffed effort to develop the land-water-land subsystem of container-oriented logistic systems.

(10) The Air Force has the predominant interest in the land-air-land subsystems. It relies on air transportation to a significant degree in the resupply of its units, and it operates the air terminals. It should, therefore, lead a jointly staffed effort in developing the land-air-land subsystem.

b. Recommendations

(CN-9) The Logistic System Policy Committee task the Departments of the Army and the Air Force to lead jointly staffed efforts to coordinate the development of land-water-land and land-air-land container-oriented logistic systems, respectively. The thrust of these efforts should stress the "how" and not the "whys" of containerization, and be directed toward early development of container-oriented logistic systems. In order to ensure the incorporation of all relevant considerations and maximize the probability of prompt implementation of recommendations, the senior Service representatives engaged in the joint efforts should be responsive to their respective Services as well as to the Director of the joint effort.

(CN-6) The Services jointly develop and test the capabilities and procedures for the conduct of logistics-over-the-shore container operations. Based on the results of these tests, the Services should establish their requirements for a family of containers, containerships, and container handling equipment to support logistics-over-the-shore operations and should procure sufficient quantities of this equipment for ensured support of a contingency operation in underdeveloped areas.

(CN-4) The Joint Chiefs of Staff determine the numbers and types of container-capable ships that must be in the Military Sea Transportation Service nucleus fleet in order to implement a containerization policy that will provide the resources necessary to meet requirements for peacetime support, and for contingency operations until such time as commercial containership service can be made available and operational in the contingency area. Other recommendations that relate to this subject appear in the Transportation Monograph.

(CN-5) The Secretary of Defense seek to have the legislation stemming from the President's Merchant Marine Program include positive provision for ensuring the responsiveness of modern U.S. flag containerships with gantry crane rails installed to meet military requirements under various conditions of emergency. Other recommendations that relate to this subject appear in the Transportation Monograph.

APPENDIX A

AMERICAN POWER JET COMPANY REPORT

To assist the Joint Logistics Review Board in the review of containerization, the Department of the Army contracted with the American Power Jet Company, Ridgefield, New Jersey, for an analysis of the experiences gained by the Services in using containers during the Vietnam era. This report is attached as Appendix A. The Board gave general endorsement to the overall thrust of the report, as well as the advantages and problems highlighted in the report findings; however, the Board did not verify all data and the analysis contained in the report.

APJ 589-212

CONTAINERIZATION

Based on Lessons of the Vietnam Era (Executive Summary)

prepared for

JOINT LOGISTICS REVIEW BOARD

Washington, D.C.

by

AMERICAN POWER JET COMPANY

705 Grand Avenue

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January 1970

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....IN BRIEF

The reader of this report may ask "How can a metal box influence the course of the war?" In fact, it can.

The investigation, study and analysis of experience with containers (the military Conex and commercial Seavans) during the Vietnam Era, show conclusively that a full containerization policy would have had a profound effect on logistics. Rapid response and economies in time, manpower and money would not only have materially improved logistics support but would also have permitted major changes in buildup and combat strategy.

This executive summary outlines and condenses the detailed analyses of the basic report. Our major findings are:

1. Almost all military cargo is containerizable; the rest may be moved by roll-on/roll-off. This applies both to the initial movement of unit equipment and to the resupply of our forces.

2. Containers can be used as substitutes for covered and refrigerated storage and are especially useful in eliminating both facility requirements and intermediate rehandlings of cargo. To do this, a mix of containers in appropriate sizes is required, but they must be modular and readily combinable into standard increments for handling and movement.

3. If full containerization had been employed during the Vietnam Era, over \$880 million, including 33 million manhours, would have been saved in transportation, handling, port facilities, ship delays, and shore facilities. At 1968 levels of operation (support of approximately half a million men), \$120 million, including almost 10 million manhours, would have been saved each year. Deep-draft berth requirements would have been cut to less than half.

4. Even more important, the troop buildup could have been effected in less than half the time. The troop deployment rate could have been increased by approximately 60 percent.

5. To attain this potential requires that the rebuilding of the U.S. Merchant Marine take into account the military requirements of containerization and roll-on/roll-off. Additionally, research and development must energetically pursue and bring into being economical systems for getting containers across the shoreline and moving them inland. The basic technology exists; it requires development.

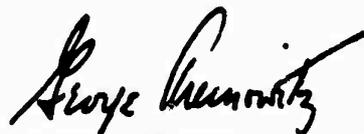
6. Containerization is entirely compatible with air deployment, particularly for the C-5A and B-747.

7. The military logistic system must have available and in being, a hard-core mix of cargo aircraft, vessels, and equipment.

8. Containerization and roll-on/roll-off concepts must be made a part of contingency readiness planning. The standardization and simplification potential of containerization and roll-on/roll-off procedures will facilitate contingency planning and shorten response time.

9. There is great opportunity for management and control to enhance supply visibility and permit real time management. To exploit this opportunity requires improvements in documentation, depot procedures, and packaging standards. It has implications for transportation engineering which reach beyond the military system and which will have favorable effect on the nation's economy.

10. Containerization creates a need for system-wide Federal and DOD policies, and a system-wide approach to management. Military personnel must have hands-on experience with containerized operations if potential economic and effectiveness gains are to be actually achieved.



George Chernowitz, Director
American Power Jet Company

EXECUTIVE SUMMARY

SCOPE

APJ Report 589-5, "Containerization, Based on Lessons of the Vietnam Era" provides the results of a study of containerization related to logistic support of the Vietnam operation from 1965 to 1969. Experience with containerization during the period is used as the basis for determining results that might have been obtained had maximum containerization been applied.

Three major elements of container-supported logistic operations are analyzed to identify those lessons learned which are applicable to future policy, management and operations. The elements analyzed are:

- o Cargo and Cargo Distribution
- o Equipment and Facilities
- o Management and Control

In each area, the probable trends for the 1970 - 1980 time period are projected, and their probable impact on cargo distribution operations is assessed. Particular attention is given to containerized distribution.

The facts, lessons learned, and assessment of future trends lead directly to findings and policy implications that are applicable to future military, container-supported logistic operations.

CARGO AND CARGO DISTRIBUTION

Report Page
Reference

Facts and Findings

2-11 to 2-17
2-35 to 2-39

1. Most military cargo is containerizable. The balance can be moved effectively as RO/RO cargo.

It was found that about two-thirds of the cargo moved over the four year period (1965-1968) was containerizable. Potential containerization relative to total cargo and 20' container equivalents are shown on Table 1.

TABLE 1. POTENTIAL CARGO CONTAINERIZATION, CONUS TO RVN, 1965-1968, INCLUSIVE

Calendar Year	Total Cgo. (000) M/T	Containerizable Cgo. (000) M/T	Percent Containerizable	No. 20' Equiv. Cont. Req'd. (000)
1965	2,682	1,374	51	15.8
1966	6,800	4,064	60	43.4
1967	9,713	6,818	70	73.5
1968	10,238	7,644	75	82.1

Unit moves in the 1965-1966 period, involving large amounts of Class VII wheeled and tracked vehicles (considered non-containerizable) resulted in lower percentages during those years. Resupply cargo is highly containerizable, as shown by the higher percentages for 1967-1968.

Measures of containerizability in this study are based on an analysis of each supply class and tend to be conservative (see Table 2).

TABLE 2. MILITARY CARGO CONTAINERIZABILITY FACTORS (EXCLUDING BULK POL)

Supply Class	Percent Containerizable
All Classes	100
-- EXCEPT --	
IVA - Lumber	80
IVB - Metal	50
IVD - Other Construction Materials	80
VII - Major End Items	0
IX - Repair Parts	80

Although no Class VII items were considered containerizable, many are, in fact, well adapted to container movements. Most wheeled and tracked vehicles, small aircraft and helicopters, can be moved in standard containers, and when RO/RO ships or aircraft transports are not available, container movement may be the preferred mode of shipment. Also, only 80 percent of repair parts were considered containerizable, an estimate considered highly conservative.

All cargo considered non-containerizable in this study can be moved as RO/RO cargo. It can be transported either on its own wheels or tracks, or loaded on vehicles (flat beds, etc.). Containers on chassis can also be moved as RO/RO cargo, if containership service is not available. Very large and very heavy cargo (locomotives, etc.) will require heavy lift equipment for RO/RO vessel loading and unloading.

Report Page
Reference

2-54 to 2-72
3-5,3-10
5-6,5-11

2. Containers meet requirements and have applications in the military logistic system in areas other than cargo movement.

Containers provide mobile, relatively inexpensive storage facilities for both dry and reefer cargo. In Vietnam, 49,200 20' equivalent dry cargo containers and 4,300 reefer containers would have met 59% of total dry cargo and 100% of reefer cargo covered storage requirements. This capability is particularly valuable during the early stages of a contingency operation (Table 3).

TABLE 3. CONTAINER COVERED STORAGE POTENTIAL, VIETNAM OPERATIONS, 1965-1968, INCLUSIVE

Type Cargo	Total Requirement (cu.ft.)	Container Potential (cu.ft.)	% of Total	Containers Required
Dry	64,062,000	37,800,000	59	49,200
Reefer	2,728,000	2,728,000	100	4,300

The concept of the container as a storage facility envisions a policy of continual rotation, with containers returned to CONUS when empty. Block stowage of cargo within containers for easy location and issue is recommended.

Other container applications include their use as binned storage facilities, pre-packed unit move supply modules, administrative facilities, and for direct user support in certain commodity areas. User support, in terms of direct shipment from CONUS origin to the ultimate user, seems particularly applicable to such commodities as rations, packaged POL, PX items, some types of ammunition, and some levels of repair parts.

**Report Page
Reference**

Container loading of predetermined mixes of supply items tailored to known unit strength and demand factors would permit direct user support with significant savings in cargo packaging, packing and handling.

2-40 to 2-53
3-2 to 3-29

3. Maximum containerization produces significant savings in cost, manpower and time.

The rapid sea and aerial port throughput capability resulting from containerization reduces the number of berths, piers and other port facilities required to support a given level of operation. In Vietnam, 34 deep-draft berths at five major and two minor ports were required to support the breakbulk operation. Under full containerization, this requirement could have been reduced to 14 berths.

Cargo handling requirements at ports and depots are reduced. Rapid ship turnaround eliminates demurrage costs and permits a smaller pipeline investment. The reduction in the number of ports required, and the use of containers for storage facilities reduces construction requirements. Additional savings result from decreased pilferage, loss and damage to cargo, and from decreased port facility requirements, such as cargo transit sheds. Data available are not sufficiently accurate to quantify these savings.

Total potential savings for the 1965-1968 period (one-time and recurring) are estimated at more than \$880 million (Table 4). Annual recurring savings at the 1968 level of activity are estimated at about \$120 million.

Estimated potential manhour savings during the 1965-1968 period total 33 million (Table 5). Annual recurring manhour savings (dollar impact noted above) at the 1968 level are estimated at 9.8 million.

Maximum containerization augmented by RO/RO also produces major time savings. All cargo for the 310 thousand man troop buildup could have been delivered in 6 months instead of a year and a half. (See Figure 1.) This would have given the Commander a potential of about 61% additional man years of troop availability in the theater and provided a reserve capacity at each port to meet peak demands and support further troop buildup.

TABLE 4. POTENTIAL COST AVOIDANCE AND RECURRING SAVINGS WITH FULL CONTAINERIZATION (VIETNAM, 1965-1968)

Item	Amount (\$Millions)
<u>Cost Avoidance (one-time savings)</u>	
Pipeline reduction	147.2*
Port facilities	181.0
Ship delay billings	89.7
Covered storage	86.9
Refrigerated storage	<u>23.0</u>
Total Cost Avoidance	\$527.8
<u>Recurring Savings (1965-1968)</u>	
Shipments (incl. port handling)	344.6
Depot cargo handling	<u>8.9</u>
Total Recurring Savings	\$353.5
GRAND TOTAL	\$881.3

*At 1968 level of activity

TABLE 5. POTENTIAL MANHOOR SAVINGS WITH FULL CONTAINERIZATION (VIETNAM, 1965-1968)

Item	Manhours (Millions)	
Recurring Savings:	Port Handling	20.8
	Depot Handling	7.8
One-Time Savings:	Covered Storage Const.	3.2
	Reefer Const.	.8
	Deep-Draft Berths	.4
TOTAL	33.0	

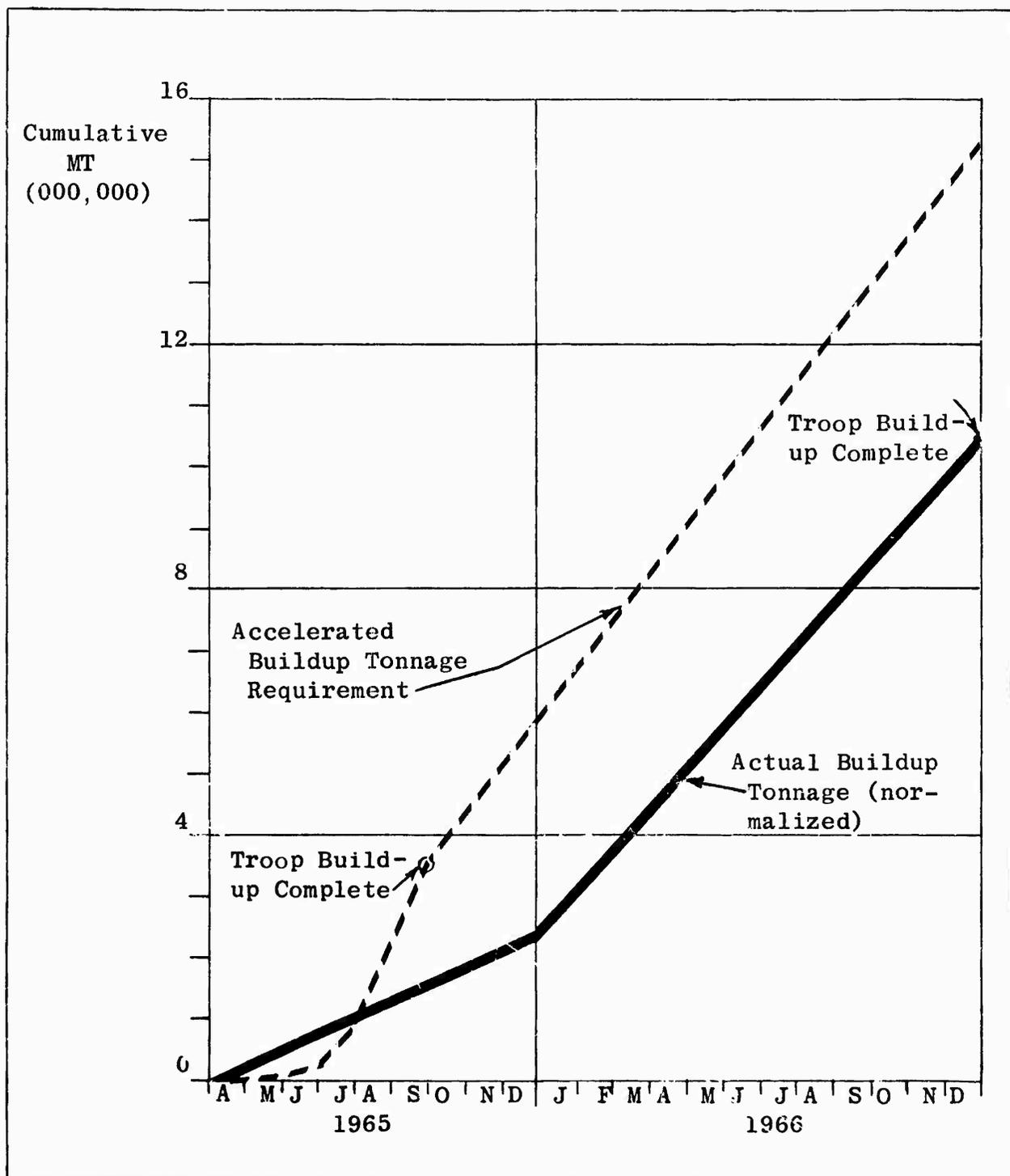


Figure 1 RVN Troop Buildup Potential

<u>Report Page Reference</u>	<u>Policy Implications</u>
7-9	1. Containerization augmented by RO/RO support should become the accepted way of moving cargo.
7-9	2. Port development planning for contingency operations should be based on the rapid installation of a limited number of berths capable of container and RO/RO ship support.
7-10	3. The application of containers for purposes other than cargo movement should be recognized and made a part of container requirement analysis.
7-10	4. The use of containers for unit supply support on an origin-to-user throughput basis should receive careful study, and actions should be taken to test the concept.

EQUIPMENT AND FACILITIES

Facts and Findings

- | | |
|--|--|
| 2-21 to 2-26
2-47, 2-48
4-17 to 4-23 | 1. <div style="border: 1px solid black; padding: 5px;">Container and RO/RO ships are more effective than breakbulk ships in support of most military operations, and particularly contingency operations.</div>
Their rapid loading and discharge capability reduces port turnaround time, and thus port congestion. In the early stages of the Vietnam operation, dry cargo vessels available to MSTs were breakbulk ships. Many came from the National Defense Reserve Fleet and were obsolete and in poor condition. Breakbulk shipping, combined with limited port capability in Vietnam, produced severe port congestion problems, some of which could have been avoided had containerships been available in sufficient quantities. |
| 6-9 to 6-14 | 2. <div style="border: 1px solid black; padding: 5px;">Augmentation of the MSTs controlled fleet through normal procurement methods is time consuming.</div> |

Report Page
Reference

Emergency requisitioning authority was not used in the Vietnam era. The lead time for acquisition of contractual containership support was more than a year. It is probable that for future requirements, a minimum of six months would be required for completion of contract actions and marshalling of vessels at appropriate ports of embarkation.

2-21 to 2-26
2-47, 2-48
4-14, 4-15
4-17 to 4-22
5-6, 5-12

3. The changing composition of the U.S. Flag merchant fleet resulting from the rapid increase in commercial containerization has serious military implications.

The U.S. merchant fleet is rapidly becoming containership dominated. Consequently, commercial capability to support military break-bulk shipping is declining. At the end of 1968, some 40% of the total fleet was containerships. This percentage will increase as ships on order and under construction are completed.

Most commercial containerships are non-selfsustaining. Non-selfsustaining support becomes feasible only after pier, equipment, and security requirements have been met. The time required for pier construction or improvement, and installation of shoreside container handling equipment indicates a military requirement for selfsustaining ships to support contingency operations in their early stages.

2-7, 2-46
3-25, 3-26
4-32 to 4-36
6-12, 6-13

4. The ship/shore interface presents problems in container over-the-shore movements.

During the early stages of a contingency situation, a requirement for a capability to transfer containers from a ship in the stream over the shore line can be anticipated. Harborcraft equipment in Vietnam did not have this capability. Much of the equipment available in the early part of the operation was found to be non-standard and in poor condition. (Equipment available in 1968 could handle containers on chassis and RO/RO items, but was not designed

Report Page
Reference

to move demounted containers over the shore.) Modern equipment, designed for this purpose and in a high state of readiness is required. The Lighter Aboard Ship (LASH) concept has possibilities for this type of support. Heavy lift helicopters and ground effects machines may also provide a ship discharge capability which eliminates ship/shore interface problems. Other alternatives currently under study, illustrated in Figure 2, may serve as effective LOTS interface equipment.

4-39

5. Military tractors used for container land transport in contingency operations, must be capable of hauling heavy loads over poor roads and in mountainous terrain. Tractors used in Vietnam were frequently unsatisfactory under these conditions.

2-11, 2-12
4-40, 4-41
4-64, 4-65

6. New, large aircraft types (C-5A, B747, and others) have a capability to move containerized cargo and to lift a higher percentage of total military cargo requirements than current aircraft types.

While it can be expected that sealift will continue to be the major transportation mode for oversea cargo movements, the current airlift share (about 2%) can be expected to increase. These new aircraft provide a capability to move large items previously considered ineligible for airlift. They provide both a container and RO/RO capability, which will reduce aerial port congestion through more rapid aircraft turnaround.

4-41 to 4-47

7. An adequate quantity of modern, ready interface equipment (MHE, heavy lift) is necessary for military container operations.

Equipment must be well suited for container stuffing and for lift and transfer of the loaded container. It must be capable of sustained operation under high workload and adverse environmental conditions. As noted earlier, a satisfactory shore based lift capability at the shoreline is essential to

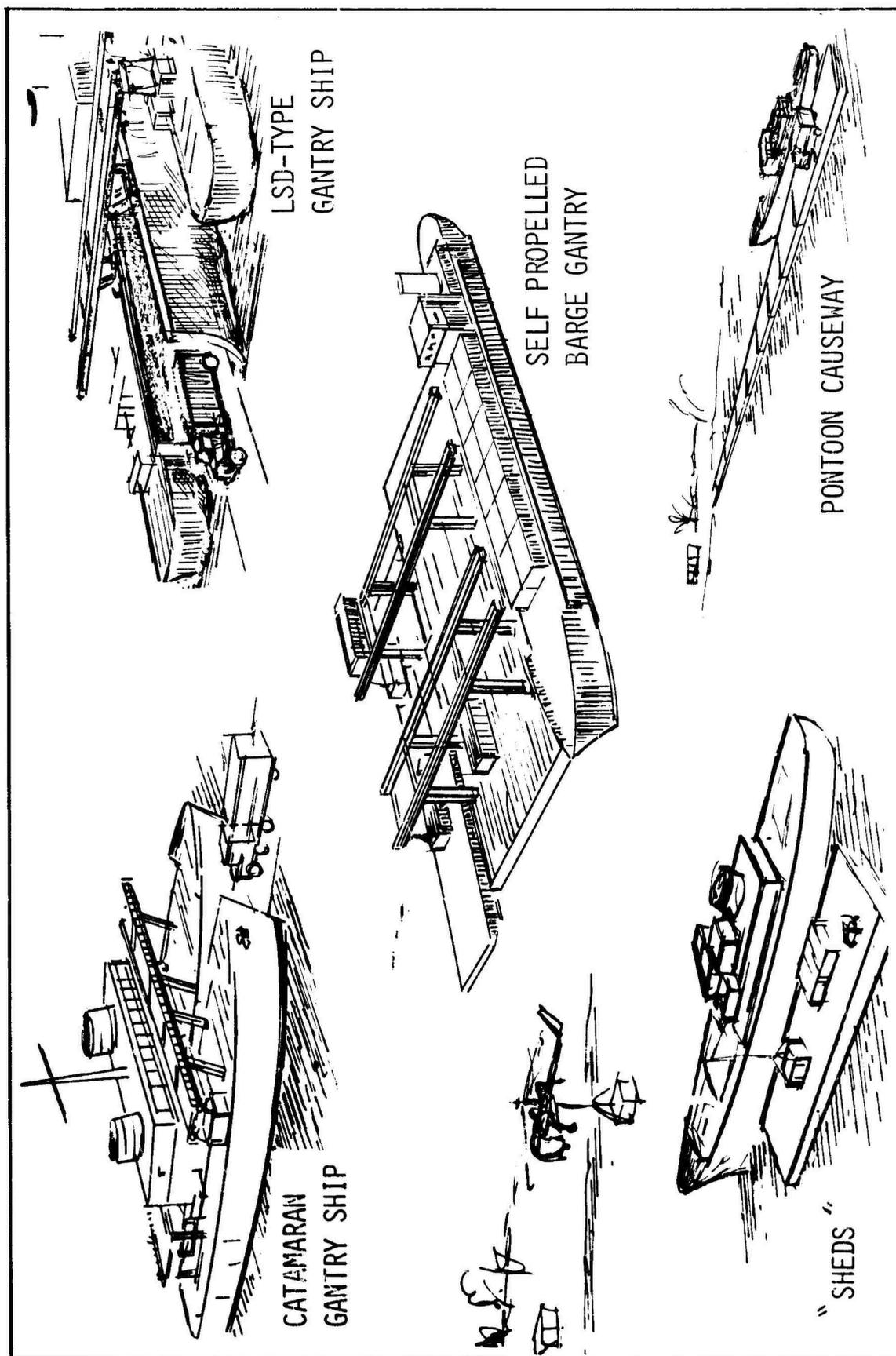


Figure 2 Alternative Ship-Shore Interface Modules

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Reference

- a LOTS operation. Equipment shortages and low readiness presented interface equipment problems in the early part of the Vietnam operation.
- 4-22, 4-23 8. Military containers will be required in various lengths and heights.
- International standards prescribe container lengths, including 5, 6-2/3, 10, 20, 30, and 40 feet. These modules and dimensions available from their coupling provide flexibility in meeting user requirements and capabilities for movement and lift. It is probable that military operations will produce requirements for standard containers of various lengths.
- Height standards have generally been set at a maximum of 8 feet. For very dense cargo, i.e., cement, some types of ammunition), container weight limitations make 4 foot high gondola type containers more efficient.
- 4-59 9. A quick means of modifying intermodal containers for use in applications other than cargo movement is necessary.
- Movable partitions, removable panels, easily mountable and demountable binning are examples of modifications which would permit rapid conversion of a container to an administrative or supply facility.
- 2-49 to 2-55 10. Depot and port facilities must be designed to
3-25, 3-26 meet container operation requirements.
4-60 to 4-65
6-13
- Large, improved marshalling yard areas are required at both depots and ports. The location of depot loading and unloading areas should facilitate warehousing and require minimum cargo rehandling. Loading dock heights should be compatible with container van floor heights. In Vietnam, separation of loading areas from warehouses created requirements for multiple cargo handling. Varying loading dock heights in Vietnam depots produced less serious problems.

Report Page
Reference

Rapid port construction is required, and the use of LASH type vessels to transport mobile pier sections to the area of operations may be feasible.

4-60, 4-61

11. Current depot procedures for issuing, packing and packaging shipments are affected by containerization.

Preplanned, direct shipment from origin to user would reduce the amount of packing and packaging required for protection prior to use. Container block stowage and prebinning would simplify issue and receipt and also reduce packing and packaging requirements.

4-65 to 4-69

12. There is a requirement for reliable information regarding the total transportation environment.

Containers, and equipment associated with container operations, must be capable of reliable operation under the natural and induced environments common to worldwide military operations. Application of environmental knowledge in equipment design and packaging criteria is essential to an effective and economical military container operation.

Policy Implications

7-13

1. The use of emergency requisitioning authority as a basis for military ocean transport augmentation cannot be assumed for future contingency operations.

7-13

2. The trend in industry toward non-selfsustaining containerships and away from breakbulk shipping must be recognized in military logistics planning. Provisions for rapid ship conversion concepts to make non-selfsustaining ships self-sustaining should be pursued.

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Reference

7-13

3. The continuing requirement for RO/RO vessels should be recognized and actions taken to insure that an adequate number of such ships are available for military support.

7-15,7-16

4. There is a major requirement for developing a capability for over-the-shore movement of cargo including demounted containers.

7-16

5. Actions should be taken to insure that the harborcraft and other equipment required for over-the-shore movement of demounted containers and other military cargo are modern, in a high state of readiness, and meet standardization criteria.

7-19

6. The current military highway fleet should be reviewed and necessary actions taken to insure an adequate capability for movement of heavy loads (including loaded, intermodal containers) in a contingency environment.

7-20

7. Maximum containerization of airlift cargo for new, large aircraft types should be a matter of policy. A thorough study of optimum cargo eligibility for these aircraft with their increased container carrying capability, is required.

7-22

8. An adequate supply of modern, standard interface equipment must be provided for military container support of a contingency operation.

7-25

9. Containers used for military operations should conform to established standards unless non-standard containers offered by an operator can meet total container requirements for an operation.

7-24

10. Development of easy-to-install container modification kits should be programmed to improve container capability for use in areas other than cargo movement, such as administrative and supply facilities.

Report Page
Reference

7-26, 7-27

11. Depot and port (sea and aerial) construction and renovation programs should be related to large-scale container operations.

7-28

12. Acquisition, validation and application of environmental data related to the total military distribution system (including transportation, handling and storage) should be pursued.

MANAGEMENT AND CONTROL

Facts and Findings

5-2 to 5-17

1. The introduction of the intermodal container into the commercial and military transportation systems creates a need for system-wide Federal and DOD policies.

Existing policies dealing with cargo movements are oriented to individual transportation modes rather than an integrated, throughput container distribution system. Few Federal or DOD programs, directives or regulations dealing specifically with containerization were found. Actions being taken by DOD components and agencies form a basis for ultimate DOD containerization policies and programs.

5-15

5-19 to 5-25

2. Containerization requires system-wide management.

A segmented and mode oriented management approach militates against the attainment of overall cost and effectiveness benefits. A management concept providing centralized policy control would provide optimum benefits in military container operations.

3. Military personnel need "hands-on" container management experience in specifically military applications.

This type of experience was not gained from the contract operation in support of Vietnam. The U.S. Army Materiel Command Milvan Pilot Operation would provide valuable experience in many

Report Page
Reference

areas of military containerization management and a means for supporting advances in the concepts governing military container operations.

5-28, 5-29
5-34

4. Military container consolidation/distribution points to serve shippers with less than container load shipments are required for efficient container management and utilization.

5-19 to 5-22

5. Conex experience indicates that management policies and control procedures must be system-wide to reconcile the conflicting demands of transportation versus field facility uses of containers.

5-26 to 5-31

6. Current military performance accounting and reporting procedures are not conducive to system-wide performance appraisal.

Procedures are oriented toward vertical command operating programs and budget structures and do not provide overall visibility of the entire throughput system.

5-41 to 5-45

7. Current UMMIPS standards do not recognize system-wide tradeoffs which may improve total performance.

5-45 to 5-50

8. Current cargo documentation procedures for container movements resulted in problems in documentation, intransit cargo visibility, and in-theater cargo receipt accounting.

5-36 to 5-41

9. Charter conflicts between single managers (MTMS and MSTS) and the lack of a clear assignment of responsibility between ports and depots for container unstuffing, prior to continued movement in the breakbulk mode, produced problems.

Report Page
Reference
6-11 to 6-13

10. The government has a requirement for ownership, control or guaranteed access to sufficient quantities of ships (container and RO/RO), containers (with required chassis and tractors), LOTS and interface equipment, and mobile piers to provide prompt support to contingency requirements.

The following items would permit support of a two-Division force deployed 7000 or more miles from CONUS, through the first 90 days and indefinitely thereafter:

- a. 10 selfsustaining containerships of 850 20' equivalent container capacity.
- b. 6 RO/RO ships of the ADMIRAL WILLIAM M. CALLAGHAN type with 15,000 MT cargo capacity.
- c. 6 self-propelled lighters capable of carrying at least 6 containers each or equivalent, including barges and tugs.
- d. 2 Beach Discharge Lighters similar to the LT. COL. JOHN U. D. PAGE.
- e. 38,000 20' equivalent containers (30,000 8' high and 8,000 4' high).
- f. 22,000 chassis
- g. 4 land-based mobile cranes capable of lifting loaded 20' containers.
- h. 1 DeLong type pier (700' x 90') with reinforced decking.
- i. 2 gantry cranes, and 2 RO/RO interface units.

The use of large aircraft for movement of container and RO/RO cargo would eliminate the requirement for some of the sealift capability.

Policy Implications

7-32, 7-33

1. Containerization management policies should provide for integrated management of cargo movement and container fleets, consolidation/distribution centers, improved visibility through improved performance accounting and reporting, and control of the military container fleet.

Report Page
Reference

- 7-33 2. Containerized cargo documentation should relate supply and transportation information, provide better in-transit cargo visibility, simplify in-theater receipt and accounting and provide system-wide performance measurements.
- 7-33 3. A clear delineation of management, control and operating responsibilities for container operations is required at all levels of management and operation.
- 7-33 4. Policies and programs for early acquisition of a limited number of military-owned intermodal containers with related transport and materials handling equipment should be implemented.
- 7-36 5. The Department of Defense should own, control or have guaranteed access to sufficient vessels, containers and chassis to support a determined level of contingency operations until commercial augmentation can be obtained.
- 7-36 6. The Department of Defense should own, and place in reserve stocks, mobile pier units, gantry cranes, mobile heavy lift equipment, and lighterage equipment in sufficient quantities to support container operations at the level determined for 5. above.
- 7-33 7. The system-wide technical and management implications of containerization are such that new and revised materiel and management systems must be developed, tested and validated to insure the prompt application of lessons learned.

APJ 589-5

CONTAINERIZATION
Based on Lessons of the Vietnam Era

prepared for

JOINT LOGISTICS REVIEW BOARD
Washington, D.C.

by

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PREFACE

The Vietnam era witnessed both the large-scale adoption of the intermodal container by industry and its progressive introduction into Vietnam support operations. The objective of this report is to analyze the actual performance of containerization during this period and assess its potential for common-user military logistics of 1970-1980.

Every effort has been made to insure that this report properly represents the underlying physical, operational and organizational facts which are essential to sound conclusions. Our major conclusion is that full containerization would have produced significant cost, manpower and time savings. It also recognizes that such savings can be attained only by disciplined and continuing effort involving far-reaching actions in the areas of transportation, supply and contingency planning.

The report objectives and frame of reference are detailed in Chapter 1. Actual cargo characteristics, distribution experience, and the containerizability of each military supply class are established in Chapter 2. The potential impact on cost and time, had the requisite containers and supporting equipment been available in sufficient quantity from the outset, is calculated on a total cost basis in Chapter 3. Facilities and equipment implications are analyzed from engineering and operational points of view in Chapter 4. Finally, Chapters 5 and 6 discuss considerations pertinent to management and control, as well as container systems availability for contingency operations.

The treatment of the above topics in substantially self-contained chapters makes summarization essential. Therefore, in Chapter 7, the lessons learned and policy implications are drawn together and summarized, and future trends (1970-1980) in each area are identified, based on probable state-of-the-art advances.

"In Brief" provides the thrust and key conclusions for executive levels in two pages.

This report was prepared by George Chernowitz, Manley Clark, James Ciccotti, Carl Schone, Andrew McKeefe, Paul Muzio, and Lee Metcalfe of the American Power Jet Company, Ridgefield,

New Jersey and Arlington, Virginia. The major burdens of calculations and report preparation were capably handled by Barbara Boren, Dolly Heidt, Mary Healey, Virginia Marzocchi and Kathleen Fleureton.

Full cooperation was extended by the Joint Logistics Review Board and their staff throughout our efforts. In particular, we gratefully acknowledge the support of Col. Ronald D. Bagley, Col. Reuben E. Wheelis, and Lt.Col. Joseph G. Mattingly, Jr. Stimulating discussions with individual members of the Board were the source of insights and a deeper understanding of the considerations involved.

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CHAPTER 1
INTRODUCTION

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INTRODUCTION

BACKGROUND

The many problems of logistic support of a rapidly expanding contingency operation were all encountered in the Vietnam conflict. Existing port facilities, (both sea and aerial), depot facilities, highway, rail, and communication networks in the country were all inadequate for support of large scale operations. The decision to embark on a rapid buildup of combat troops prior to the establishment of a logistic base and the distance from the CONUS base to Vietnam resulted in severe strains on the limited support capability within the country.

Severe problems, although ultimately resolved, were felt in all areas of the logistic structure. Port congestion produced delays of weeks in unloading ships. Depot congestion combined with lack of depot facilities resulted in supplies being lost and damaged, and frequent requisitioning of items in the theater but not locatable. Contract assistance was widely used in cargo handling and distribution functions.

Resolution of these problems was achieved, to a large extent, by large scale construction programs, manpower augmentation and management effort. By the end of 1968 most facility problems had been met and cargo distribution was controlled and efficient. A major contributor to the resolution of these problems during the interim period was found in cargo unitization and specifically in containerization.

Conex containers were used extensively in Vietnam, both for cargo movement and as a substitute for the storage and other facilities

that were not available. The development, by industry, of large intermodal containers during the same time period also offered promise of relieving some of the many logistic problems of Vietnam. The use of intermodal containers for cargo movements to Vietnam started in 1967, and rapidly demonstrated the advantages obtainable from the concept.

The rapid expansion of containerization in both the military and commercial environment had consequences of direct interest to the Department of Defense^{1/}. The substitution of containerships for breakbulk ships as principal carriers of cargo was important. The availability or lack of defense features in the new ships became a matter of concern. Military capability to support cargo movements in terms of facilities, equipment and manpower was affected by the containerization concept. Policies and procedures related to military management and control of cargo movements were likewise affected by containerization. Of particular importance was the potential impact of containerization in a military contingency operation environment.

OBJECTIVES

The objectives of this study are, therefore, to:

- a. Assess the effect of containerization and RO/RO during the Vietnam era and its effect on logistic support operations.
- b. Determine the results that would have been obtained under a policy of maximum containerization.

^{1/} In this Report, we use the phrase "Department of Defense", or "DOD" to include the services and other elements which in total comprise the Department of Defense.

- c. Analyze the capability of industry to provide responsive container service and the consequent requirement for military-owned containers, ships, and supporting materiel.
- d. Analyze implications of containerization on the management and control of cargo distribution and transportation.
- e. Examine future trends in both hardware and management related to container operations.
- f. Draw the lessons learned from the foregoing and establish their implications for future policy and courses of action during the 1970-1980 time frame.

STUDY APPROACH

The analysis is organized to cover three major areas of operation in the cargo distribution function which are affected by containerization. These are:

- 1. Scope of operations, including cargo characteristics, quantities moved, movement modes, and resource requirements.
- 2. Equipment and facilities, to include interface.
- 3. System management and control, including military ownership and control considerations.

For each area of operation analyses are made of operations, the impact of containerization on Vietnam operations and the potential impact of a full containerization policy. Major parameters used as the base for establishing containerization effects are measures of men, money, materials and time.

Additionally, for each area of operation a review of future trends is made. This review considers probable advances in systems, procedures and technology which can be expected in

the 1970-1980 time period and their potential impact on container operations.

From these analyses, a series of policy implications and recommended courses of action for optimum military container operations are provided.

STUDY BOUNDS

The study is accomplished within the following general frame work:

1. Time frame of the Vietnam era is defined as from 1965 to the beginning of 1969. (1965-1968 inclusive time period)
2. Military and commercial containerization are analyzed, including Conex, and roll-on/roll-off support.
3. Both export and retrograde military cargo movements are analyzed, including movements by surface and airlift.
4. Cargo movement requirements for all DOD military services are covered, but AID and nation building requirements are excluded.
5. The 20' x 8' x 8' intermodal container equivalent is used as a basis for container requirement estimates.
6. The requirements and movement of bulk POL and bulk dry cargo are excluded from all calculations.
7. Movements within CONUS for support of CONUS military users are excluded.
8. Intraservice distribution of military supplies accomplished by other than common user service is excluded.

CHAPTER 2

**CARGO DISTRIBUTION AND CONTAINERIZATION
IN THE VIETNAM ERA**

CHAPTER 2

CARGO DISTRIBUTION AND CONTAINERIZATION IN THE VIETNAM ERA

HISTORY OF CONTAINERIZATION

The unitization of cargo for movement by surface or air has long been the goal of logisticians, particularly those engaged in the transportation and distribution of goods. The advantages of unitization are many and obvious. The reduction in handling requirements, damage, pilferage and loss produces major savings in transportation costs and shipping time.

Maritime

Containerization is one means of cargo unitization, and has had a major application in the maritime trade. Breakbulk operations, involving the individual handling and stowing of cargo, one case at a time, has been a costly process accounting for more than half the total cost to the shipping line operator.

The concept of containerization is not a new one. There is evidence of its use as early as 1911, when a large container (18' x 8' x 8') was advertised in the National Geographic Magazine. However, the first major effort to apply containerization on a large scale was made by the U.S. Army with its Conex Program. In FY 1947, the Army purchased 23 experimental type Conex containers, and subsequently, purchased an additional 323 containers for test. In FY 1953, 2,498 Conex containers were purchased by the Army and two years later, the Army purchased an additional 10,000 containers, and the Air Force procured 5,000 Type I Conexs (a smaller version of the Army type). Eventually, some 200,000 Conex containers were purchased by the Army and Air Force for their use.

The Conex container provided several major advantages over breakbulk shipping. It provided greater flexibility in carrying goods of varying sizes and shapes than palletization, which in itself represented a major advance in unitization. The ability of the Conex to carry bulk solids and liquid commodities, and to protect goods against damage and pilferage, also represented major advantages for this type of shipment. The Conex weight and size limitations were such that individual boxes could be handled by any ship boom and by materials handling equipment normally available at any port. However, although extensively used by the military, acceptance of the Conex concept by shippers and transportation operators was limited. Their small size limited the economic benefits which could be obtained by their use and they were leapfrogged by the van-container.

The real breakthrough in containerization came in 1956, when the Pan-Atlantic Steamship Co. (the predecessor of Sea-Land Service, Inc.), borrowed from the wartime practice of carrying deck cargo on spar decks superimposed above the weather decks of tankers. Starting in 1956, two tankers were so employed carrying experimental containers between New York and Houston. In 1957-1958, the company converted six C2 type vessels to containerships.

Matson Navigation Co. on the west coast to Hawaiian trade developed experimental containers in 1957, and the next year, fitted out six of their C3 type vessels to carry 75 containers each on deck.

Major increases in the use of containers and the development of containerships to carry

them have occurred in the short period since 1958. By the end of 1968, there were 13 U.S. Flag shipping lines operating containerships and three more lines had placed orders for containerships. The fleet had 114 operating containerships at the end of 1968, and with the additional ships on order, this number will increase to more than 146.^{1/}

The growing trend has also been joined by foreign flag shipping lines.

Thus, there has truly been a "Container Revolution" in the Maritime industry which is rapidly changing the whole concept of Maritime cargo movement. Its effects have been widespread, and probably the total effect still remains to be seen.

Airlift

The 463L pallet, which functioned as a small, "wall-less" container was used extensively in Vietnam airlift operations. The system was efficient, as confirmed by the recurring shortages of pallets and the problems resulting from the time required to load and unload the aircraft when such shortages made pallets unavailable. The shortages which frequently resulted from the "temporary" diversion of pallets to support tactical emergencies, indicate the usefulness of the pallet in meeting requirements beyond the immediate task of facilitating aircraft loading and discharge. There has been a significant increase in airlift cargo unitization in recent years, with unitized cargo increasing from 26 percent of total free world air

^{1/} Annual Review of Transportation Trends, FY 1969, Hqs. MTMTS, September 1969.

freight in 1965 to an expected 57 percent in 1970.^{1/}

The introduction to service of the "Jumbo" aircraft (Boeing 747, Lockheed L500, Air Force C-5A) in the immediate future can be expected to produce significant changes in containerization of airlift cargo. These aircraft have the capability to move truly intermodal containers, and the Land-Air container will result in significant changes in cargo distribution by air.

Rail

As a result of increasing competition from the highway trucking industry, railroads also developed their own containerization systems, which closely paralleled those of the shipping industry. The original method was a piggyback system by which wheeled highway semi-trailers were carried on flat-cars. From this, special containers separable from the highway chassis were developed. Both systems are in use by railroads today.

In summary, the era of the 1960s has seen rapid and major growth in the concept of containerization and the use of containers. This growth can be expected to continue at a high rate over the next few years, as is evidenced by the shipbuilding programs in being and the advent of large aircraft capable of hauling intermodal containers.

ISSUES

Large quantities of goods were moved to Vietnam by Conex containers throughout the 1965-1968 period, but the use of large intermodal

^{1/} "What's In the Air for Aluminum Containers", Viola Castang. Air Transportation, February 1969

containers for support of Vietnam did not commence until 1967, with its main impact felt in 1968. Even in 1968, the capability to move Government cargo by containers was severely limited by the number of container-ships and containers available.

In this chapter, an analysis of cargo distribution and containerization in support of the Vietnam operation during the 1965 through 1968 time period is presented.

The following major issues are discussed:

1. Quantity and type of total cargo moved to and from Vietnam.
2. Extent of cargo which was containerized and additional quantities which could have been containerized had sufficient intermodal containers been available.
3. Worldwide military and commercial shipments and the use of intermodal containers in these shipments.
4. Impact that the intermodal containers could have had, had they been available, on construction and facility requirements, and internal supply and deployment operations in Vietnam.
5. Number of intermodal containers required to meet the total cargo distribution and the other applications in Vietnam.

DISTRIBUTION OPERATIONS IN THE VIETNAM ERA

Distribution operations during the Vietnam era have evolved through several stages during the course of the conflict. The major stages can be identified for this

discussion, as the:

Pre-buildup
Rapid Buildup
Consolidation
Disengagement.

In the pre-buildup stage, most cargo destined for Vietnam was shipped from CONUS depots and vendors to west coast military sea or aerial ports. From these ports, it was loaded aboard breakbulk ships or aircraft, and moved either to Vietnam directly or to the 2nd Logistical Command in Okinawa, which provided backup support to Army forces. Cargo shipped directly to Vietnam, for the most part, was received at the Saigon water port or the Tan Son Nhut airport. Military cargo was treated very much as commercial or AID cargo, with little emphasis on specialized development of surface or air distribution methods, facilities or equipment.

The decision to move combat troops into Vietnam in large numbers, starting in 1965, produced severe strains on the distribution system. The lack of an established logistics base and the need for creating a logistic infrastructure concurrent with the troop buildup strained all elements of logistic support.

During this rapid buildup stage, supplies were brought into Vietnam as rapidly as possible. Major emphasis was placed on insuring that sufficient supplies were available to support combat troops, rather than on conventional supply control procedures, until such time as an adequate infrastructure could be constructed and a logistics establishment capable of sophisticated supply control could be made operational.

During this period (mid-1965 - late 1966), cargo continued to move primarily by break-bulk ship. Some units were moved to Vietnam complete with their equipment, but by late 1966, nearly 75 percent of all passengers were moved by air.^{1/} Airlift was also used for priority cargo, but accounted for a small part of the total tonnage moved.

Waterborne cargo, during this period, continued to flow to Okinawa and Vietnam, with every effort made to direct shipments to the final point for which it was intended. Initially, most waterborne cargo was received at the Saigon port. However, as port facilities at Cam Ranh Bay, Da Nang and Qui Nhon were improved and developed, direct delivery of increasing amounts of cargo to these ports was possible. Cargo shipped from Okinawa to Vietnam ports moved on RO/RO and conventional vessels on regular shuttle runs.

Air shipments also were concentrated at the Tan Son Nhut airport in the early part of the rapid buildup stage, but as additional airfields, capable of handling jet aircraft, were developed, shipments also were consigned to other air terminal areas.

Upon arrival in Vietnam, cargo went into one of three Army and one Navy staging points: Saigon, Cam Ranh Bay, Qui Nhon, and Da Nang, located in the immediate port areas at these locations. Redistribution within Vietnam from these points was made primarily by truck, and in some areas (particularly, the Da Nang area), by coastal vessels (LCUs, LSTs, barges, etc.). Some cargo was distributed by air (CV-7, C-130 aircraft), but air distribution represented a small part of the total. Small sections of railroad were also opened and carried considerable tonnage, particularly, in the Qui Nhon area.

^{1/} MTMTS Briefing for the JLRB, 10 June 1969, "The Vietnam Period"

During this stage, there was very little retrograde cargo to CONUS, ranging from 10 to 15 percent of shipments into Vietnam. However, substantial amounts of unserviceable equipment was sent from Vietnam to Japan and Okinawa for overhaul.

The large scale use of Conex containers contributed to the improved supply and transportation control from 1965 through 1969. These containers facilitated not only the movement of cargo into Vietnam, but also the location, interim storage and later issue of these supplies. They provided more than six million square feet of covered storage and were a major element in support of unit moves and redeployments.1/

Following the rapid buildup stage, a consolidation stage occurred, starting in early 1967. The establishment of a sound logistic base, coupled with the completion of the major construction programs, permitted the regularization of supply and transportation systems during this period. Emphasis was placed on supply control and management, inventories were brought under control and retrograde shipments, resulting from excessing actions, increased.

Cargo shipments followed the pattern described above, with surface shipments made to the various major ports in Vietnam, and air shipments to the various air terminals. Cargo consignments to Vietnam were also initiated from east coast depots and vendors directly to Vietnam during this period, thus eliminating the necessity for cross country shipment to west coast ports prior to loading for Vietnam.

1/ Briefing to JLRB by Lt. Col. Mattingly, Chief, Containerization Branch, Trnsp. Div., Directorate of Distribution and Transportation, Army Materiel Command, August 1969

During this period, the use of large intermodal containers and containerships for cargo movement to Vietnam was initiated, through a contract with Sea-Land Service, Inc., with container shipments consigned to Da Nang using selfsustaining vessels, and to Cam Ranh Bay using both selfsustaining and non-selfsustaining ships. Containers have been used to move both dry and reefer cargo, and are currently being tested for use in ammunition movements.

The current stage in the Vietnam conflict is one of gradual disengagement and troop redeployment. Cargo distribution patterns have not changed; however, inland transportation has become increasingly secure. During this period, increasing emphasis has been placed on supply and transportation management, with emphasis on reduction of inventories and return of excesses. Increased control, and the refinement of management procedures to permit efficient operations under more austere funding programs, are characteristic of distribution operations at this time.

The detailed discussion of containers and containerization which follows is laid in the overall framework of distribution operations discussed above. The container, in its Conex version, has played an important part in supply distribution since the start of the Vietnam conflict. The larger, intermodal container has become increasingly important as its development and application have responded to the need for the service it provides.

CARGO CHARACTERISTICS

Containerizability

In the following discussion, the containerizability of cargo shipments to and from Vietnam during 1965-1968 is reviewed. Containerizability of an item depends, primarily, upon its weight and dimensions in its normal shipping configuration, the container size, and the economics of shipment by container.

An intermodal container is defined as a reusable receptacle with outside dimensions equal to or greater than 5' long, 4' or 8' high, with a standard width of 8', designed to be moved by all modes of transportation and fitted with standard corner devices and other fittings required for handling and transfer from one transportation mode to another. However, most containers used in U.S. trade are 20' long or greater. A complete description of containers and container standards is contained in Chapter 4.

Obviously, items larger than the container in any dimension are not containerizable. Very dense items are generally containerizable, but for large containers, their weight results in the container weight limitation being reached with only a portion of the volume being used. However, the use of smaller containers rapidly increases the efficiency of containerizing such items. Some items, i.e., wheeled vehicles, can be more efficiently moved by other means, such as RO/RO ships.

In this study, each commodity class was analyzed to establish its containerizability. The 20' container was considered the basic container against which determinations of containerizability would be made, except where otherwise noted. While there are larger containers in use, few items are eliminated by using a 20' container.

Export Cargo (CONUS to RVN)

Airlift

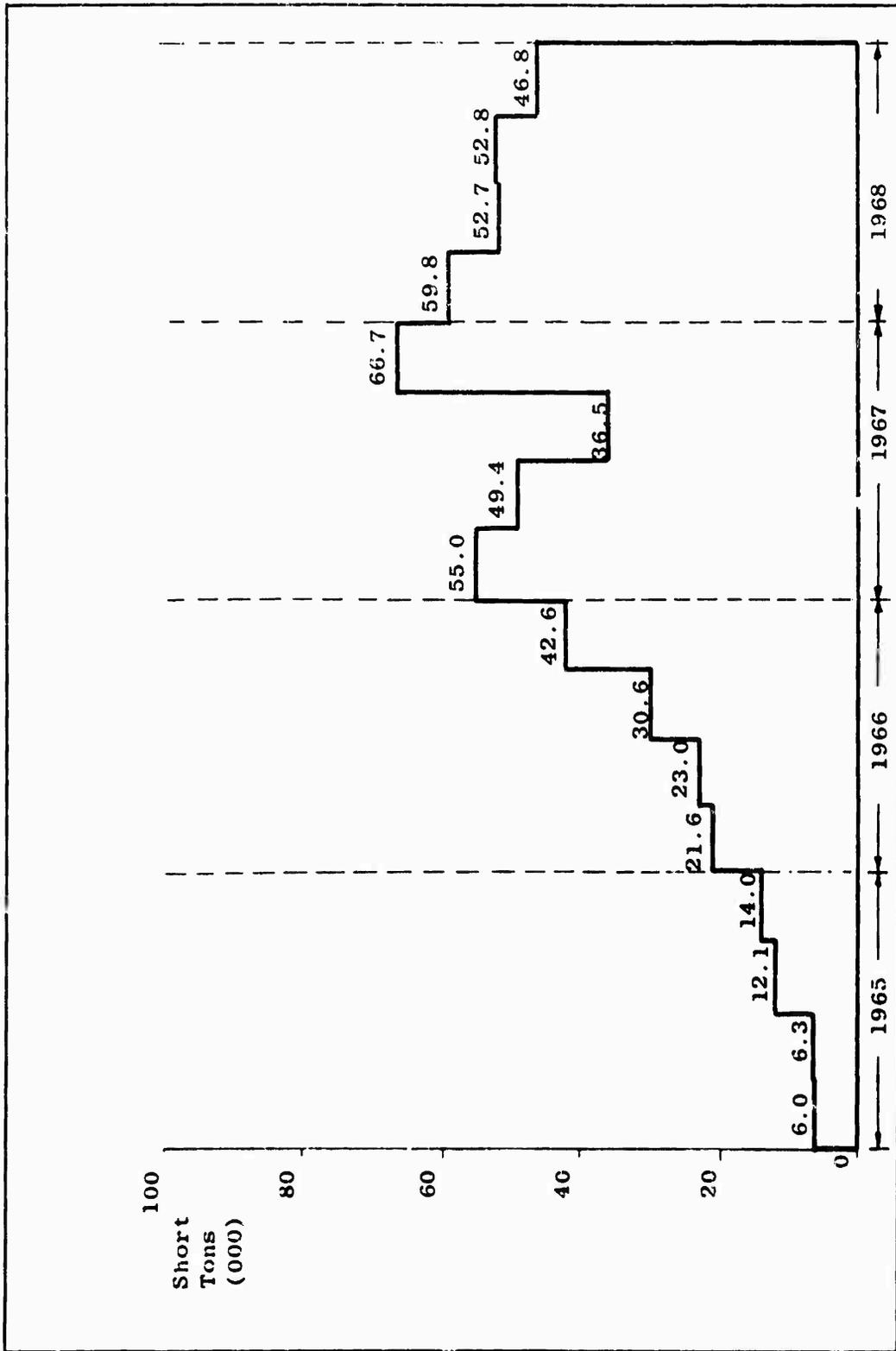
Military airlift of supplies from CONUS to RVN played a major role in providing rapid movement of critically needed items and reducing the pipeline of high value items. During 1965-1968, 575,000 ST of cargo were airlifted, consisting primarily of engines, transmissions, and other critical repair parts for equipment down for maintenance, much of which was moved under super priority requisitioning procedures, such as "Red Ball".

Airlift capability, however, was generally inadequate to meet all requirements for movement of airworthy cargo. Although the situation had improved by 1968, considerable diversion still took place. A small amount of cargo was also carried in Navy and Air Force tactical support aircraft, however, MAC airlift accounted for most air cargo movements.

The cargo and mail airlift tonnage in 1966 was three times the 1965 figure, and the 1967 volume was twice that of 1966. Air shipment tonnage began to level off in the first quarter of CY 1968, and dropped thereafter (Fig.2-1).

The low average density (less than 20 lbs/cu.ft) and volume characteristics of airlift cargo permit the assumption that it is all containerizable in 20' or 40' containers.

Although MAC used small, special purpose containers for mail, they were not intermodal. While containers might have relieved cargo congestion at APODs, the standard size intermodal containers could not be efficiently airlifted with most aircraft types available, although 20' standard containers could have been carried on C-141s.



Sources: SASM Statistical Reference Books 1965-66 and 1967; SASM Statistical Digest 1968-1969

Figure 2-1. Cargo and Mail Movements, CONUS to Vietnam,
Military Airlift Command

Surface Lift

During the period 1965-1968, 29.5 million MT of supplies were shipped to PVN from CONUS under the DOD Sealift Program. It is estimated that two-thirds of the cargo moved during the period was susceptible to containerization, with 75 percent containerizable in 1968, (see Table 2-1).

The analysis leading to this determination follows:

Class I - Subsistence. All Class I supplies are containerizable. Average density for dry subsistence is 33 pounds per cubic foot^{1/} and for chill subsistence items, 29.4 pounds per cubic foot.

Class II - Clothing, Individual Equipment, etc. Class II supplies have an average density of 21.5 pounds per cubic foot, and are 100 percent containerizable.

Class III - POL. Packaged POL ranges in density from about 60 pounds per cubic foot for lubricating oils to 32 pounds per cubic foot for grease, with an average density of 52 pounds per cubic foot. All packaged petroleum products are susceptible to containerization. In general, a 20' container can be filled to 80 percent with POL products without exceeding its gross weight limitation. While liquids can be shipped in bladders in containers, other methods are generally more economical, therefore, bulk POL is not considered containerizable.

Class IV - Construction. Construction material consists primarily of lumber, metal, cement and other materials. Lumber is considered to be 80 percent containerizable, with a density of 32 pounds per cubic foot. Wood products (plywood and masonite, are prime candidates for container

^{1/} Density factors shown for the supply classes were obtained from FM 55-15, "Transportation Reference Data", FM 5-35, "Engineers' Reference and Logistical Data", JCS Pub. 15, APJ Rpt. 504-1, "U.S. Army Cargo Containerization Requirements". In one or two cases, where reference data could not be found, estimates based on cargo manifest analysis were used.

Supply Class	Average Density (lbs/cu ft)	(000) MT Cargo Moved, CONUS-to-RVN			
		1965	1966	1967	1968
I	33.0		424	704	847
II	21.5		1,301	1,776	1,602
III	52.0		55	58	88
IVA-Lumber (80%)	32.0		527	914	999
IVB-Metal (50%)	65.0		137	267	219
IVC-Cement	95.0		34	99	28
IVD-Other (80%)	45.0		119	276	469
VI	23.5		486	903	1,016
VIII	25.0		26	21	15
IX (80%)	26.0		130	152	188
X	16.0		47	65	48
Total Dry		1,034	3,286	5,235	5,519
V	19.2	285	581	1,283	1,748
I (Reefer)	29.4	55	197	300	377
Total Con- tainerizable		1,374	4,064	6,818	7,644
IVA (20%)	32.0		132	213	243
IVB (50%)	65.0		137	267	219
IVD (20%)	45.0		30	69	117
VII End Items Other than Aircraft	10.6		2,260	2,015	1,759
VIIE Aircraft	.9		144	294	209
IX (20%)	26.0		33	38	47
Total Non- Containeriz- able		1,308	2,736	2,895	2,594
GRAND TOTAL		2,682	6,800	9,713	10,238
Percent Containerizable		51	60	70	75

Source: "Total Tonnage to Vietnam" furnished to JLRB
Task Force E by MTMTS

Table 2-1. Containerizable and Non-Containerizable
Cargo by Supply Class, CONUS to RVN

shipment, as the container provides excellent protection from the elements.

Metal is considered 50 percent containerizable, with a density of 65 pounds per cubic foot. Because of the high density of most metal products used in construction, (nails in kegs, barbed wire, etc.), 20' x 8' x 4' containers will normally be more efficient than larger sizes. Cement has a density of 93 pounds per cubic foot, and will also be more efficiently shipped in 20' x 8' x 4' containers. It is an excellent item for containerization because of the protection against the elements provided by the container. Other construction material has an average density of 45 pounds per cubic foot, with 80 percent considered containerizable.

Class V- Ammunition Supply Class V is considered 100 percent containerizable. 20' x 8' x 4' containers may be more efficient for moving selected, high density types of ammunition.

Class VI - Personal Demand Items. Supply Class VI consists primarily of PX items, with an average density of 23.5 pounds per cubic foot (JCS Pub. 15). Personal demand items are considered to be 100 percent containerizable.

Class VII - Major End Items. Major end item surface movements consisted primarily of tanks, tracked military vehicles, other military vehicles, construction vehicles, aircraft and other. The average density for aircraft is 0.93 pounds per cubic foot and, for the remaining sub-classes is 10.6 pounds per cubic foot. Although some individual Class VII items can be shipped in containers, many are too large for containerization, and most wheeled vehicles can be shipped more efficiently in RO/RO vessels than in containers. Therefore, this commodity class is considered as non-containerizable.

Class VIII - Medical Materiel. Supply Class VIII has a density of 25 pounds per cubic foot and is considered 100 percent containerizable.

Class IX - Repair Parts. Repair parts are made up of a mixture of dense and balloon items, with an average density of 26 pounds per cubic foot. While most items can be physically placed in a container, it is considered that approximately 20 percent of the repair parts tonnage may not be moved efficiently in containers. Therefore, in this study, Class IX supplies are considered to be 80 percent containerizable.

Class X - Non-Military Support Materiel. Although most supplies in Supply Class X can be moved in containers, the small amount shipped to RVN during the period studied indicates container shipment would have been inefficient. Therefore, this supply class was considered non-containerizable.

Tonnages containerizable and non-containerizable, by Class of Supply shipped from CONUS to RVN over the period studied, and the average density for each class are listed in Table 2-1.

As shown in this table, over the four year period covered, approximately 33 percent of the total cargo moved to Vietnam is considered non-containerizable. However, Class VII end items accounted for most of this type of cargo, ranging from 76 percent to 88 percent of all non-containerizable cargo for the three years for which detailed data are available.

Class VII end items, except for aircraft, can be carried most efficiently on RO RO ships.

Large aircraft are normally flown to the place of use, and smaller aircraft are either airlifted or carried on aircraft transports or other sealift. Containers, however, can carry certain types of aircraft disassembled, and many Class VII items. RO/RO can, therefore, be "backed up" by containers.

Other non-containerizable cargo consists primarily of large items which exceed container dimensions. These items, too, can be readily moved by RO/RO vessels, seatrains, LASH type vessels or aircraft transports. Hence, they could have been moved to the area of operation with no remaining requirement for breakbulk ship support. Extremely large and heavy items, such as locomotives, barges, and the like may require a heavy lift crane for ship loading and unloading.

Retrograde Cargo (RVN to CONUS)

Airlift

Air retrograde shipments consisted primarily of mail and high value, critical components returned for overhaul. All of this cargo is considered containerizable.

Surface Lift

Retrograde tonnages moved by surface lift have been relatively small through 1968. Approximately half of the tonnage has been in commodities designated "special" (outsize cargo, including vehicles) and "aircraft". All general cargo was suitable for containerization, (Figure 2-2).^{1/} By the end of 1968, all retrograde cargo that could be containerized was containerized, and special cargo was being shipped back to CONUS on seatrains.

^{1/} MSTS Financial and Statistical Report, 7700-2.

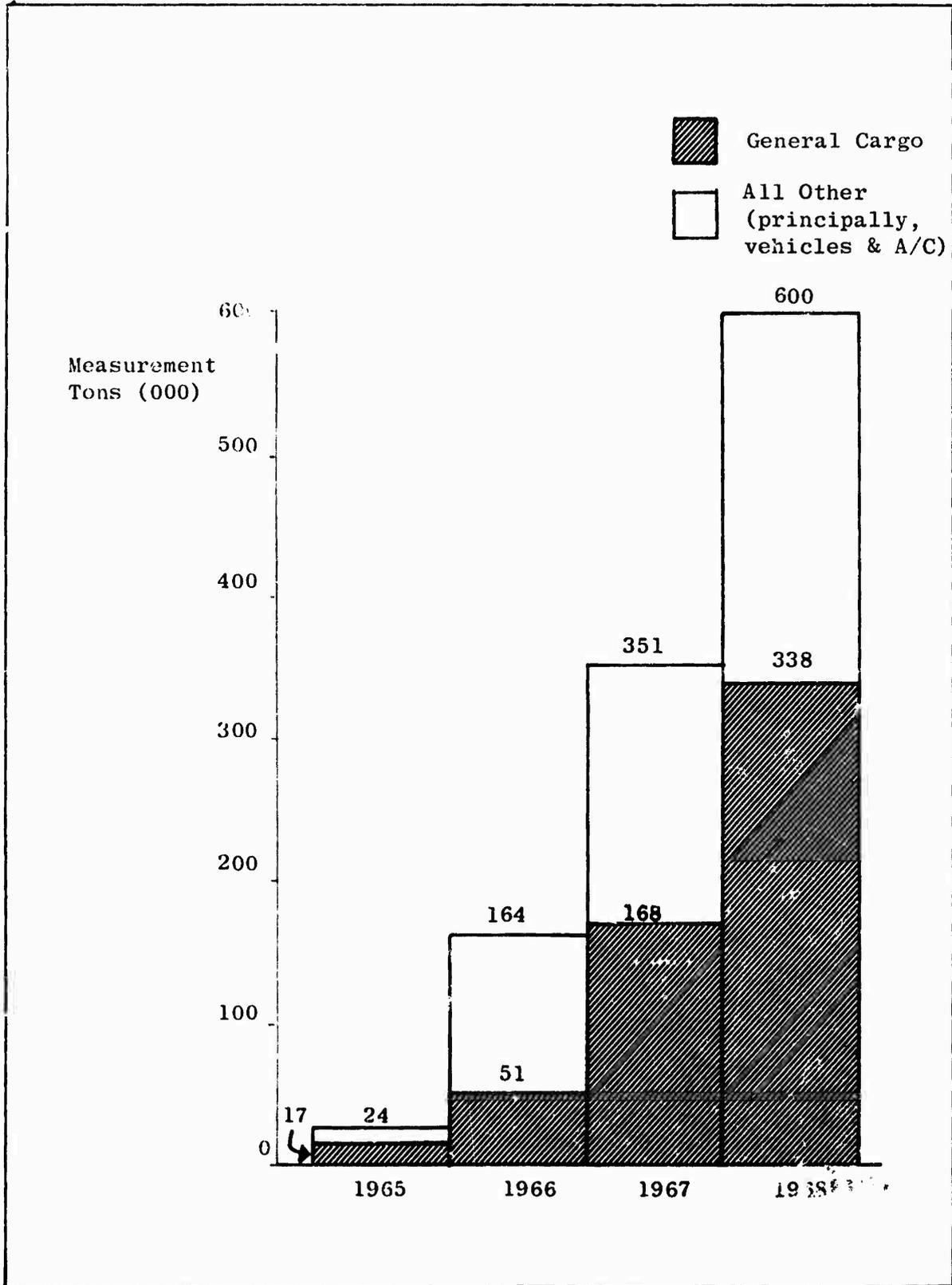


Figure 2-2. Retrograde Surface Movements, RVN to CONUS

VIETNAM CONEX EXPERIENCE

The forerunner of the intermodal container is the Conex, used extensively by the U.S. Army and Air Force. The Type I Conex, used by the Air Force, has exterior dimensions of 4'3" x 6'3" x 6'10 1/2", an interior volume of 135 cubic feet, and a weight capacity of 9,000 pounds. The Type II container, used by the Army, is an 8'6" x 6'3" x 6'10 1/2" box, with an interior volume of 295 cubic feet and a weight capacity of 9,000 pounds.

The Conex can be readily transported on a flat bed truck or railcar, and requires little special handling equipment. It provides for a single lift at POEs and PODs, and gives intransit protection to its contents from environmental factors and pilferage. In addition, the Conex provides covered storage space when a shortage of such space exists, and Conexs, fitted with plywood bins in various sizes, have been used as repair part support packages. Conexs have also been extensively used in unit moves.

As of the end of CY 1968, there were 199,166 Conexs in existence. Today, there are few Conexs left in CONUS. Of those shipped to Vietnam, (approximately 78 percent of the total inventory) virtually all remained and are being used for covered storage and other purposes. Between 1966 and 1968, 156,287 Conex shipments, carrying approximately 938,000 MT were made to Vietnam. (See Table 2-2.) Of the approximately 156,000 Conexs shipped to the Republic of Vietnam, only 17,500 were returned to CONUS.

During the period 1967 through 1968, the implementation of the Sea-Land Service, Inc. to Vietnam essentially replaced the lost transport capability of Conexs retained in Vietnam.

	1965	1966	1967	1968	Total
Conex Inventory	97,784	123,747	201,446	199,166	N/App
Number of Conex Shipments to RVN	N/Av	40,266	80,441	35,580	156,287
Number of Conexs Used in Unit Deployments	N/Av	9,785	8,802	2,452	21,039
MT (000) to RVN in Conex	N/Av	242	483	213	938

Table 2-2. Scope of RVN Conex Operation ^{1/}

^{1/} Source: Tab A to Letter, Hq. AMC to JLRB, 8 Nov. 1969, Subject "Conex and Packaging Information Request"

INTERMODAL CONTAINER SERVICE

Background

The problems of port and depot congestion in Vietnam during the rapid buildup period, discussed earlier, were resolved to a large extent, by early 1968. One of the factors resulting in improvement was the use of intermodal containers and containerships.

The possible application of intermodal containers as a means of reducing port workload, and thus, port congestion in Vietnam was quickly recognized, and studies of the use of containerized shipping were completed early in 1966.^{1/2/}

These studies compared time and cost factors for the delivery of breakbulk and containerized cargo from CONUS to RVN. Also compared were the number of pier days each type of shipping would require in RVN, which was translated into the number of ships that would be required to transport a specific quantity of cargo to RVN. The use of containerships to move the annual tonnage assumed in the study would have reduced the required pier days by a factor of 15.3, and the number of ships by a factor of 2.5.^{3/} These factors result from the comparative capability to discharge a 24,000 MT load from a containership in less than two days, and 7,000 MT from a breakbulk C-2 or Victory ship in 8-10 days. Reductions in pilferage, estimated to be running at 15 to 20 percent in RVN, were also considered in the analysis.^{2/}

^{1/} "Inadequate Port Facilities and Off-Loading Delays", OASD (I&L), 14 January 1966.

^{2/} "Analysis of Containerships and Other Fast Turn-Around Shipping Systems for RVN Logistic Operations", OASD (SA), 8 March 1966.

^{3/} The study cited in Footnote ^{2/}above used 953,000 MT as the annual tonnage to be moved. The Victory ship and containership pier days were 798 and 52 respectively, with the resultant requirement for 15 and 6 ships, respectively.

Containership capacity and the capability to receive and process containerized shipments to RVN on the order of 78,000 MT per month were not immediately available in late 1965. However, CINCPAC container requirements were discussed during a conference in Honolulu, 21 March 1966, and serious consideration was given to the use of containerized cargo delivery to reduce port and pier congestion and to expedite delivery of the cargo from the ship.

Containership Operations

In February 1966, COMSTS requested a proposal from the shipping industry for containership service to Southeast Asia. As a result of the proposals obtained, containership service was started to Okinawa on 11 July 1966 ^{1/}, and extended to include Subic Bay in April 1967. In July 1968, the Okinawa portion of the service was changed from an exclusive closed cycle to an open-end shipping agreement.

Both Naha and Subic Bay had adequate deep water port facilities and the military facilities were well established. This made the implementation relatively easy, and the lessons learned were used to advantage in starting the RVN service. The Okinawa containership service was based on a 12-day arrival schedule maintained by four converted T3 selfsustaining ships. The capacity of each was 98 reefer and 378 dry 35' containers.

Some details on port conditions in Subic Bay preceding the initiation of the containership service are important in understanding lessons learned from the RVN containership operation. When the Subic Bay containership service was started, the pier area was heavily congested and studies were under way to build a second shed/pier complex.

^{1/} The first containership to Okinawa started from the east coast in May; however, the first ship from the west coast departed 11 July 1966.

Ships were in a hold status awaiting discharge. Concurrent with the initiation of the container service, the material receiving function was removed from the pier area to permit rapid container discharge. This resulted in more rapid cargo throughput and eliminated ships in the hold status. It was also found that 9,000 MT of cargo was discharged from a containership in 18 hours, whereas, it had been taking 120 hours to discharge this amount as breakbulk.^{1/}

The contract required the backloading of a retrograde container for each loaded one discharged. In some instances, this meant containers had to be unstuffed to make empties available. To permit the retention of cargo in the containers for the full free period when needed for storage or delivery to a consignee, a container pool was established. This procedure was effected in the RVN operation, also.

Efforts to increase container service were unsuccessful as industry was unable to provide the additional service requested. In a briefing to the JLRB, this inability to get more container service was attributed to the fact that commercial carriers are reluctant to provide containers to meet a temporary military requirement on other than an exclusive contract basis, when there are insufficient resources to satisfy both commercial and military requirements.^{2/}

Efforts were continued to firm up the containership requirements to RVN by MSTTS and MTMTS planners. MSTTS personnel worked on shipping schedules and containership availability. MTMTS requested the Army, Marines and DSA to provide traffic flow patterns of general commodities to RVN as a basis for establishing through container service from inland CONUS points to RVN.^{3/}

^{1/} Navy Supply Depot, Subic Bay Briefing to JLRB

^{2/} CINCPACFLT Briefing to JLRB, 20 September 1969

^{3/} MTMTS Letter, "Through Bill/Through Container Service",
1 March 1968

Containerships to RVN

The combined efforts of the Service logistic planners, MTMTS and MSTTS resulted in March 1967 in contracts to Sea-Land Service, Inc. for exclusive containerized cargo delivery service between CONUS and RVN. Service was scheduled to start (from CONUS) 30 June 1967 to Da Nang and 15 August 1967 to Cam Ranh Bay. Actual starting dates were 10 July 1967 to Da Nang and 18 October 1967 to Cam Ranh Bay.^{1/}

A review of pertinent dates indicates that over a year passed after the request for proposals from industry and the CINCPAC container requirements conference before the first containership was underway to RVN, with much of the time consumed in preliminary planning and preparation for the new shipping service. Da Nang, which requested selfsustaining containerships was ready to receive containers before Cam Ranh Bay, which had requested non-selfsustaining ships.

Selfsustaining Versus Non-Selfsustaining Ships

Da Nang Operation

The Navy and Marine Corps selected selfsustaining containership service for Da Nang principally because of the anticipated problems in operating shore-based gantry cranes close to the combat area. Preparatory requirements at Da Nang, in addition to the deep-water berth, were chassis, tractors and marshalling area. Three C2 selfsustaining containerships, with a capacity for 226 containers 8' x 8.5' x 35', were used in the circuit from Long Beach to San Francisco to

^{1/} Sea-Land Service, Inc. Contract No. 00337SA1029,
29 March 1967

to Da Nang to Long Beach.^{1/} A ship was scheduled to arrive in Da Nang each 15 days, with an average load of 9,000 MT.

Cam Ranh Bay Operation

Containership service to Cam Ranh Bay was more complex than that to Da Nang.

First, container service to Saigon and Qui Nhon was needed. However, bends in the river restricted the length of the ship that could navigate the Saigon River. Also, the restricted turning space at Newport restricted the size of the ship that could be used to Saigon.

Second, the turning basin at Qui Nhon restricted the size of the containership that could be used for the needed container service to that port.

Third, the Army wanted shore-based gantry cranes for use when not being used by Sea-Land. The requirement for gantry cranes to be placed on the DeLong pier at Cam Ranh Bay resulted in a delay in the start of the service until 18 October. Some delay was experienced in getting the cranes in place, and considerable difficulty was encountered in getting suitable labor to install the cranes and modify the DeLong pier.

^{1/} Capacity for 60 reefer and 166 dry containers was specified. Reefer containers had 40 MT capacity and the dry 52 MT. The average load was calculated as 28MT in the reefer and 43 MT in the dry. Reefer cargo percent of fill per sailing, or per month, varies considerably depending on the ratio of freeze to chill cargo. Freeze cargo is weight limited and tends to reach the container weight limit of 43,000 lbs. at an average of 56 percent of cube capacity. (MSTS Rpt.#3, "Sea-Land Containership Service, U.S. Pacific Coast to Vietnam")

The Cam Ranh Bay service was provided with three C4-J non-self-sustaining containerhips, each having a stated capacity of 654 Sea-Land 35' containers.^{1/} To provide the required service to Saigon and Qui Nhon, one self-sustaining C2 was used as a shuttle from Cam Ranh Bay. Leaving San Francisco, the C4-Js had a scheduled arrival each 15 days at Cam Ranh Bay, with approximately 24,000 MT. The return route was to San Francisco by way of Seattle.^{2/}

Service Provided by Containership Contractor

Logistic planners realized that to be fully effective, the container system had to be managed through all segments. Also, identifiable services and equipment were needed in specific operations. Consequently, for the RVN service, the containership contractor was required to provide for:

1. Unloading the inland transport and loading the container in CONUS.
2. Spotting empty containers in metropolitan areas when required.
3. Repair and maintenance of his own equipment.
4. Receiving less than container loads and consolidating to fill containers with export cargo.

^{1/} Capacity for 120 reefer and 534 dry cargo containers was specified for the C4-J. However, the maximum capacity is 663 containers, and this quantity has been manifested on at least one voyage to Vietnam.

^{2/} Sea-Land Service, Inc., Contract, op. cit.

5. Furnishing and operating the required trucks (tractors) and providing a chassis for each container unloaded from the ship.
6. Providing inland haul within 30 miles of the port of discharge in the RVN area.

In broad terms, the contractor was committed to provide enough tractors, containers and chassis at the four ports^{1/} to perform the required services. This was initially represented by the contractor^{2/} to be 1,500 chassis, 1,500 containers and 60 tractors. Ultimately about 4,500 containers with required chassis and tractors were provided. A pool of 240 chassis and containers was provided in Seattle and 560 in Oakland. Two shore gantry cranes were obtained and installed by the contractor at Cam Ranh Bay.

Government Support Required^{3/}

The contract also required that certain support be furnished the contractor by the Government to assure the 45-day round trip (per vessel) schedule specified. Major support requirements were:

1. Priority berthing and the availability of tugs and pilots in RVN for containerships or demurrage of \$500 per hour or fraction, in 15 minute increments.
2. Availability to the contractor of one acre at each port for contractor buildings.
3. Provision of hardstands for marshalling with adequate reefer electrical outlets at Cam Ranh Bay, Saigon, Da Nang and Qui Nhon, not to exceed 16 acres at Cam Ranh Bay and 8 acres at the other ports.
4. The return of dry containers within 30 days and reefer containers within 15 days

^{1/} Da Nang, Cam Ranh Bay, Qui Nhon and Saigon.

^{2/} Support items contained in MSTC contract files.

^{3/} Sea-Land Service, Inc. Contract, op. cit.

from date of delivery to the inland point or payment of container demurrage. Containers used for any purpose other than movement to load or unload cargo are subject to per diem charges, as listed below. If containers are held beyond five days following a 40-day period for dry containers and a 25-day period for reefers, and the contractor has given the Government written notice, the Government is liable for replacement cost at rates listed below.

Item and Replacement Cost	Per Diem Rate
Tractor \$14,000	--
Container, dry cargo 6,800	\$ 2.15
Container, reefer 15,800	10.00
Container, insulated 10,300	40.00
Container, open top 7,100	2.50
Flat Bed 6,800	--
Chassis 3,500	2.65
Platform 3,500	--
Car Carrier 6,800	--

5. Reimbursement to the contractor for equipment lost, stolen or damaged beyond repair at the replacement cost listed above with no per diem. Also, if because of detention of equipment by the Government, additional equipment is required to be placed in the RVN area, the Government bears the cost of positioning and repatriation.
6. A container rental fee will be paid when the container is being moved overland in CONUS by a commercial carrier. The rental fee ceases when the container is turned over to Sea-Land or placed in a container pool.

RVN Containerized Shipping Costs^{1/}

Contract costs for delivering dry and reefer containerized cargo are specified for CONUS

^{1/} Sea-Land Service, Inc., Contract. op. cit.

export and RVN retrograde cargo. Export cargo is shipped at the per container rate when stuffed by the Government, and at the per MT rate when stuffed by the contractor. Both rates are based on an 80 percent fill objective. The \$1,525.96 cost per dry cargo container stuffed by the Government results in a cost of \$36.68 per MT when 80 percent of the capacity, or 41.6 MT are in the container. The cost per MT on this basis decreases or increases related to the percent of the fill.

For contractor stuffed containers, the delivery cost is \$36.55 per MT, with an objective of 80 percent fill. Retrograde cargo is shipped at \$25.00 per MT, but not to exceed \$1,220.77 per container. Although there is no commitment in the contract that retrograde cargo will be made available to Sea-Land, the contractor has first refusal on all CONUS export cargo to RVN within the load capability of the vessels committed.

The same basic principles applied to reefer cargo: the per container rate is \$2,610, the per MT rate is \$87.00 for export and \$61.60 for retrograde (subject to a minimum of 30 MT).

A transshipment charge of \$79.00 applies to containers originating in the Seattle area destined for Da Nang and for those from Los Angeles/Long Beach destined for the other three ports.

Ammunition Containerization

Projects were proposed by the Navy and the Army to ship ammunition overseas in containers during the past three years. In late 1966, the Navy attempted to have ammunition shipped to Okinawa in containers. Early in 1967, an Army/MSTS working group tested a model of a Freuhauf ammunition container at Savanna Army Depot, Illinois, but the project was not successfully completed.

Another project was established by OASD (I&L) letter, 28 August 1969, addressed to Army, Navy, Air Force and DSA, which directed a joint Army/Navy test of containerized ammunition shipping. An analysis was required of such elements as cost, ship turnaround time, and port capabilities. For this test, the joint task group planned the use of the standard Sea-Land 8' x 6.5' x 35' container used for dry cargo shipments.

By mid-November 1969, blocking and bracing tests and over-the-road tests had been completed, the Coast Guard had determined loading and stowing safety criteria, and by mid-December, the operations plan had been published.

The concept of the operation and the status of the project, as of 15 December, was to ship 226 container loads of selected ammunition from four Army ammunition plants^{1/} and Sierra Army Depot overland to Port Chicago. The containers were scheduled to arrive at Port Chicago between 17-20 December where they would be loaded aboard a Sea-Land containership on 22 December and depart on 23 December for Cam Ranh Bay to arrive 14 January 1970.^{2/}

The types of ammunition selected and the container loads for each type are as follows:

1/ Indiana, Lone Star, Iowa and Louisiana Army Ammunition Plants.

2/ U.S. Army Materiel Command letter, "Test of Containerized Shipments for Ammunition (OPLAN TOCSA)", 15 December 1969.

Item	# Containers
8" Propellant charge	1
155 mm Propellant charge and 8" Propellant charge	2
175 mm Propellant charge	7
155 mm Propellant charge	8
105 mm HE	130
8" Projectile	30
7.62 mm small arms ammo	4
105 mm HE	4
175 mm Projectile	10
2.75" Rockets	17
155 mm Projectile	13
Total	226

Imposed safety requirements limited the gross weight for containers loaded with high explosives to 39,000 pounds. Containers carrying other types of ammunition could be loaded to the full 45,000 pound capacity.

Containerization Experience

Sea-Land started shipments to RVN carrying highly selective cargo to insure compliance with the requirement to maintain the 80 percent container fill. As experience was gained, MTMTS developed breakeven points for 20', 35' and 40' containers. Experience showed that nearly 100 percent fill could be achieved with mail and slightly more than 50 percent with reefer freeze cargo. The commodity characteristics, primarily density, determined the percent fill that could be achieved. With dense cargo, such as reefer freeze cargo, batteries and ammunition, the container weight limit is reached before the cube volume is filled. Mail, tires and most AAFES items are balloon cargo and a high percentage of container fill can be expected.

Breakeven points can be determined for each shipping destination based on the commodities shipped when throughput cost, including protection,

ease of handling, time and other factors are considered. In discussing increased container service to RVN in 1968, MACV indicated that protection for cargo costs approximately \$25.00 per MT in packaging. It was estimated that 50,000 MT per month would require this protection if shipped to RVN as breakbulk.^{1/} MACV also estimated that one-fifth of all retrograde Army aircraft could be loaded in containers, thereby reducing preparation cost.

It is apparent that, as more is learned about containerized shipping, and as the management of the containerized system extends to cover the entire cycle from consignor to consignee, export and retrograde, breakeven points may even become unnecessary. Special containers can be developed for dense commodities, such as ammunition, cement, packaged POL and canned subsistence. Other less dense commodities can be shipped in a variety of container sizes from 10' to 40'.

Container Movements

Figures 2-3 and 2-4 show container and containerized tonnage data for shipments of dry and reefer cargo from CONUS to RVN from the inception of service in 1967 through CY 1968. As can be seen, after initiation of service to Cam Ranh Bay in late 1967, shipments have remained at approximately the same general level with marked fluctuations from month to month.

During 1968, 20,830 container loads were shipped to Vietnam, accounting for 828,600 MT of cargo. This amounted to slightly more than ten percent of the total 7,644,000 MT of containerizable cargo during the same period.

^{1/} MACV, March 1968 Briefing, "Expanded Container Service to RVN, application to Freighter Cargo"

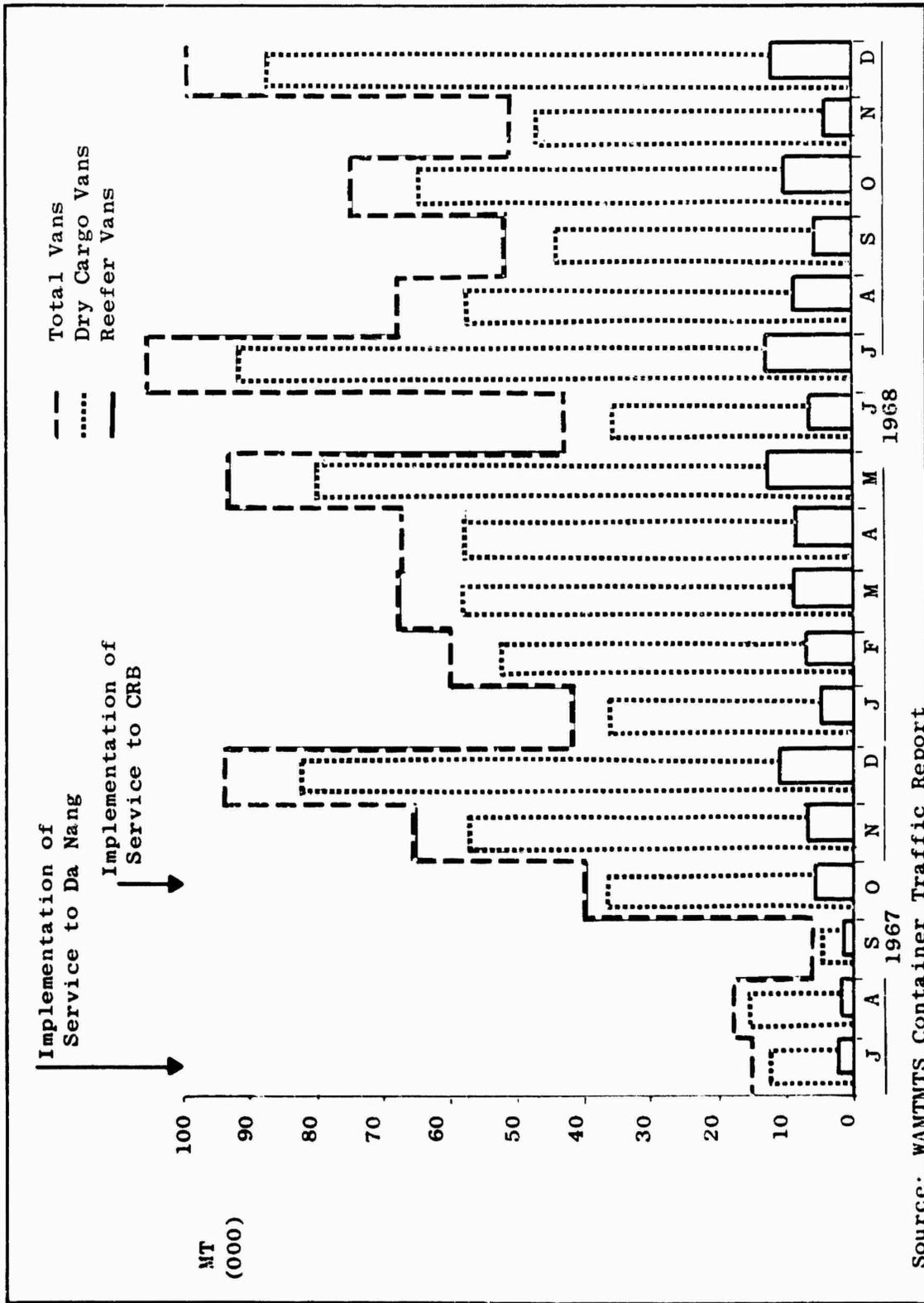
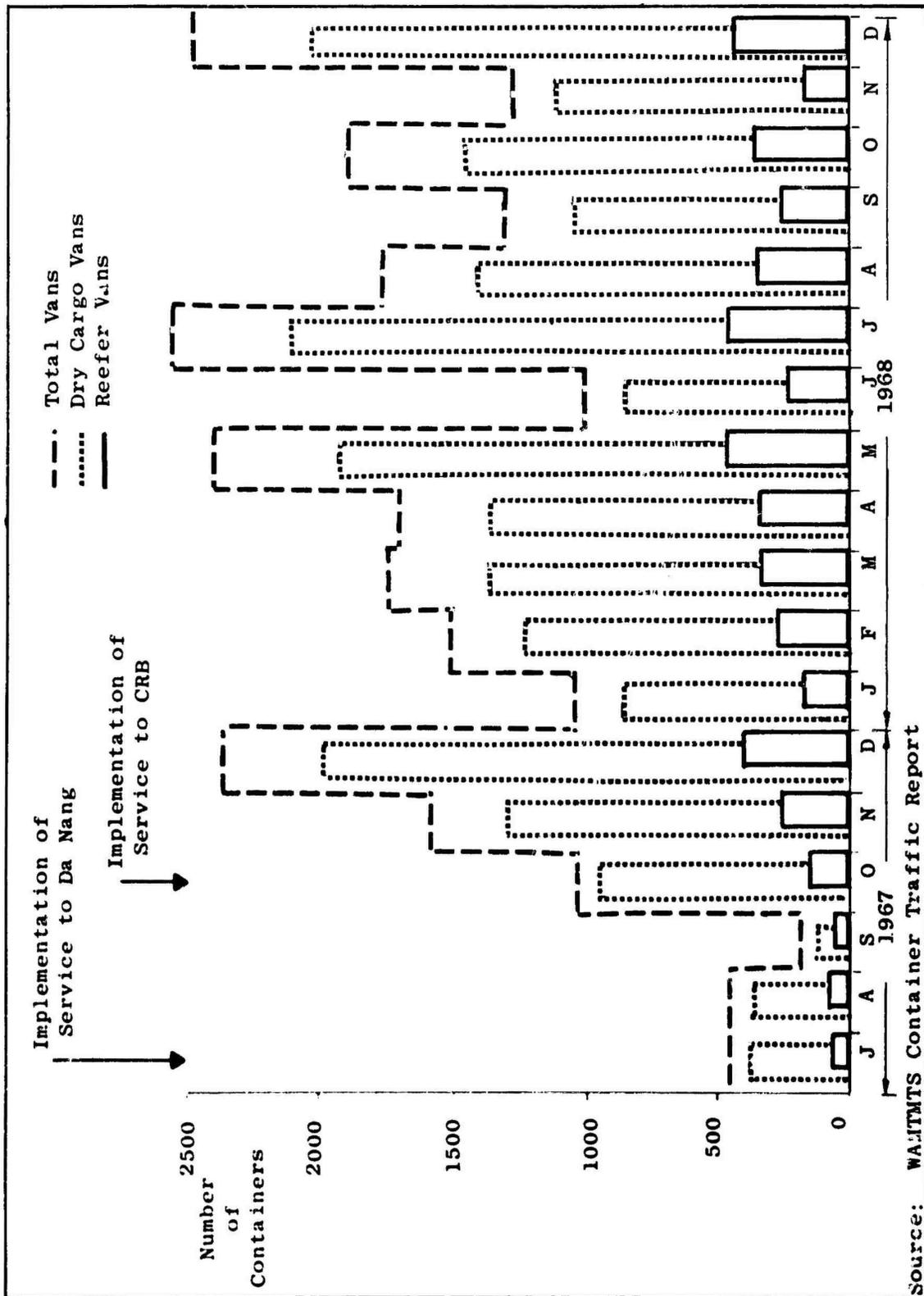


Figure 2-3. Sea-Land Containerized Cargo Shipments, WAMTMTS-to-RVN



Source: WAMTMS Container Traffic Report

Figure 2-4. Sea-Land Container Shipments, WAMTMS-to-RVN

INTERMODAL CONTAINER REQUIREMENTS FOR VIETNAM SUPPORT

Container Equivalents

The number of containers necessary to satisfy the requirements of fully containerized supply operations in Vietnam for the period 1965-1968 can be developed by using the tonnage figures in Table 2-1 and the weight and volume relationships associated with a container.

However, because of the several types and sizes of intermodal containers currently in use, it has been necessary to establish a standard family of containers against which such measurements can be applied. This permits the determination of the number of container equivalents, related to the standard set, required to move a given volume of cargo. Transposition of these equivalents to other size container requirements can generally be made by applying the relative size of other containers to the standard container, except when density rather than volume is the limiting factor. In general, weight limitations for intermodal containers tend to be constant, regardless of size.

For this study, the 20' container, as described below, was selected as the standard for measurement. Intermodal containers of this size are currently in use, are more flexible in meeting military requirements than larger containers, and can be coupled to produce a 40' container, a size also in current use by industry.

Three types of intermodal containers were selected for the standard set: an 8' x 8' x 20' standard intermodal container; an 8' x 4' x 20' for dense materials; and an 8' x 8' x 20' refrigerated container.

As shown in Table 2-3, the 8' x 8' x 20' standard intermodal container, hereafter referred to as a "dry cargo" container, has

an interior volume of 1,050 cubic feet and an average utilization of 840 cubic feet.

The smaller 8' x 4' x 20' containers are more efficient for transport of cement, heavy construction material, such as steel bars, nails, barbed wire, some types of ammunition, and other items of high density.

Type	Size (Ft.)	Interior-Cube (Cu.Ft.)	Average Utilization (Cu. Ft.)
Dry Cargo	8 x 8 x 20	1,050	840
Other Dense Cargo (Gondola)	8 x 4 x 20	500	400
Reefer	8 x 8 x 20	800	660

Table 2-3. Container Configurations

The 8' x 4' x 20' container has an interior cube of approximately 500 cubic feet and an average utilization of 400 cubic feet. It is probable that this small container would not be available from commercial shippers because of the high economic penalties associated with CONUS highway costs.

The refrigerated container has an internal capacity of approximately 800 cubic feet, and an average utilization of 660 cubic feet. The reduced interior cube results from the requirement for the refrigeration unit.

Container Load Requirements

Table 2-4 shows the number of 20' equivalent container loads for each supply class which would have been required to move all containerizable cargo from CONUS to RVN for the 1966-1968 time period. The table was derived by applying the containerizable tonnages in Table 2-1 to the average cubage for each container type. It was assumed that a container would be loaded to 80 percent of its internal capacity unless its weight capacity was reached before that point. It was recognized that, in some instances, the 80 percent volume utilization would not be attained, but that in other cases the 80 percent level would be exceeded. Sea-Land history during the Vietnam era has shown that, in most cases, the 35' containers have been loaded to 80 percent or higher. As the 20' container achieves a higher volume utilization from high density cargo than larger containers, the 80 percent utilization rate is considered reasonable.

Container Requirements

The container load data in Table 2-4, in conjunction with an assumed 75-day turnaround for each container permits calculation of the total number of containers required. The 75-day turnaround time is based on an average of 40 days sailing time, 15 days for CONUS depot and linehaul operations, and 20 days in the theater. Thus approximately one container is required for each 4.8 container loads in any given year. Table 2-5 shows the type and number of 20' containers required by year.

It should be noted that the effect of turnaround time on container requirements is linear. Thus, a reduction in turnaround time from 75 days to 60 days (20%) would produce a corresponding 20% decrease in the number of containers required. With faster ships coming into service, it is probable that reduced sailing times can be expected.

SUPPLY CLASS	NUMBER OF CONTAINERLOADS (000)			
	1965	1966	1967	1968
<u>Dry Cargo Containerloads</u>				
I Dry	N/Av	20.2	33.5	40.3
II	N/Av	62.0	84.6	76.3
III	N/Av	2.7	2.9	4.3
IV Lumber	N/Av	25.1	45.5	47.5
IV Metal	N/Av	8.5	16.5	13.5
IV Cement	N/Av	-	-	-
IV Other Const. Mtls.	N/Av	4.8	10.8	17.7
VI	N/Av	23.1	43.0	48.3
VIII	N/Av	1.2	1.0	.7
IX	N/Av	6.2	7.2	9.0
X	N/Av	2.2	3.0	2.2
Total		52.0	156.0	246.0
<u>Dense Cargo Containerloads (8' x 4' x 20')</u>				
IV Cement	N/Av	3.0	8.8	2.3
IV* Other Const. Mtls.	N/Av	1.5	2.0	3.1
Total	N/Av	4.5	10.8	5.4
<u>Ammunition Containerloads**</u>				
V 8' x 8' x 20' Cont.		10.2	20.8	45.8
V 8' x 4' x 20' Cont.		7.1	14.5	32.1
Total		17.3	35.3	77.9
<u>Refrigerated Containerloads</u>				
I Reefer		3.3	12.0	18.3
			22.8	

* Tonnage estimated

** Distribution estimated as 75% in 8' x 8' x 20' containers,
25% in 8' x 4' x 20' containers.

Table 2-4. Containerloads (by Supply Class) to
Move Containerizable Cargo, CONUS to RVN

Type	Size (Ft.)	Number of Containers (000)			
		1965	1966	1967	1968
Dry Cargo	8 x 8 x 20	13.8	36.8	60.8	67.1
Dense Cargo	8 x 4 x 20	1.3*	4.1	8.9	10.2
Reefer	8 x 8 x 20	.7	2.5	3.8	4.8
Total	—	15.8*	43.4	73.5	82.1

* Plus containers for cement and other construction materials.

Table 2-5. Container Requirements for Transportation Operations (CONUS to RVN)

It is apparent that the number of containers required for a fully containerized operation of the size of Vietnam, during 1965-1968, would be large. In terms of 20' equivalents, it would require 15 to 20 times the number of vans employed in the Sea-Land operation between CONUS and Vietnam under the original contract, and about 8 to 9 times the number called for by the current contract.

WORLDWIDE MILITARY CARGO DISTRIBUTION FACTORS

General

The interrelationships among DOD supply distribution requirements both to Vietnam and to other oversea installations, commercial cargo movements and U.S. Flag shipping warrants a brief discussion. The Vietnam supply distribution operation took place within the framework of the total DOD Sealift Program. To some extent, DOD Sealift requirements compete with commercial requirements. Some of the more important factors related to these interrelationships are discussed below.

Cargo Tonnage

Figure 2-5 shows DOD shipments to and from Vietnam, the total DOD export and import. Sealift Program, and total commercial export and import cargo carried on U.S. Flag ships, measured in short tons of cargo.^{1/}

As shown, Vietnam shipments increased rapidly between 1965 and 1967, and at a slower rate in 1968. The increase in the DOD total Sealift Program resulted mostly from the Vietnam increase, with shipments to and from other DOD oversea installations remaining relatively constant. Approximately 90 percent of both the total Sealift Program and Vietnam traffic represents export shipments.

Commercial export and import shipments carried on U.S. Flag ships are more nearly equal. As shown in the Figure, the total DOD Sealift Program exceeded commercial import tonnage for the 1966-1968 period and approximately equalled the export tonnage amounts in 1967 and 1968.

U.S. Flag vessels moved less than 10 percent of total United States import and export cargo during the period shown. Increased requirements for DOD support would tend to reduce this small share of the total market even further. This probably accounts, to some extent, for the reluctance of commercial U.S. Flag shippers to remove ships from commercial use to support DOD requirements on other than an exclusive use basis.

DOD Container Movements

Table 2-6 shows the extent to which total DOD Sealift Program was moved by containers

^{1/} Sources for this table are: Maritime Administration, Division of Trade Studies for Commercial Shipment Data; MTMTS for tonnage for Vietnam data; MTMTS Briefing to JLRB "The Vietnam Era"; 10 June 1969 for DOD Sealift Program Data.

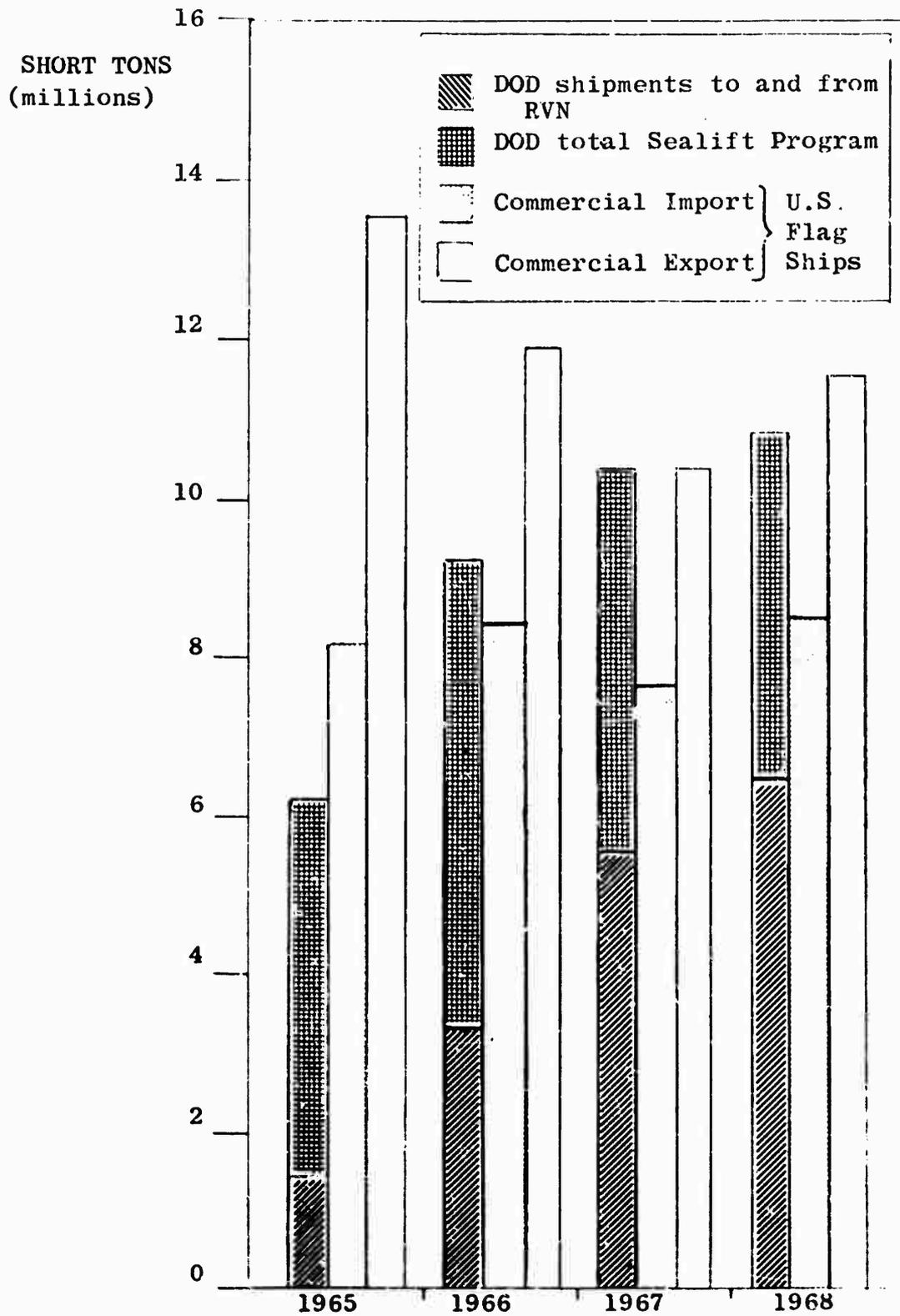


Figure 2-5 CONUS Inbound and Outbound Cargo Movements (Commercial and Military)

and the Vietnam portion of the movement. As noted above, the total Sealift Program represents approximately 90 percent export shipment from CONUS.

In CY 1968, the export portion of the total Sealift Program was approximately 20.0 million measurement tons. Of this amount, approximately 3.7 million measurement tons, or more than 18 percent, were lifted in Conex and intermodal containers. It can also be seen that container shipments to other areas than Vietnam in 1968 were nearly 3 times greater than to Vietnam.

	Measurement Tons (000)		
	<u>CY 1966</u>	<u>CY 1967</u>	<u>CY 1968</u>
Total DOD Sealift Program (Approximate)	18,500	21,000	22,000
<u>Conex Shipments (Export only)</u>			
Total Worldwide	524	797	592
RVN Portion	(282)	(314)	(379)
<u>Intermodal Container Shipments (Export only)</u>			
Total Worldwide	468*	1,785	3,134
RVN Portion	--	(241)*	(829)

* 6 Months Experience

Table 2-6. Relationship of Container Shipments to Total DOD Sealift Program (Worldwide)

Source: DOD Sealift Program-MTMTS Briefing "The Vietnam Period" to JLRB, 10 June 1969. Conex shipment data - USAMC Ltr. to JLRB, Subject "Conex and Packaging Information Request", 18 Nov. 1969. Intermodal Container Shipments-MTMTS Ltr. to JLRB, Subject "Containerized Military Cargo", 26 Nov. 1969.

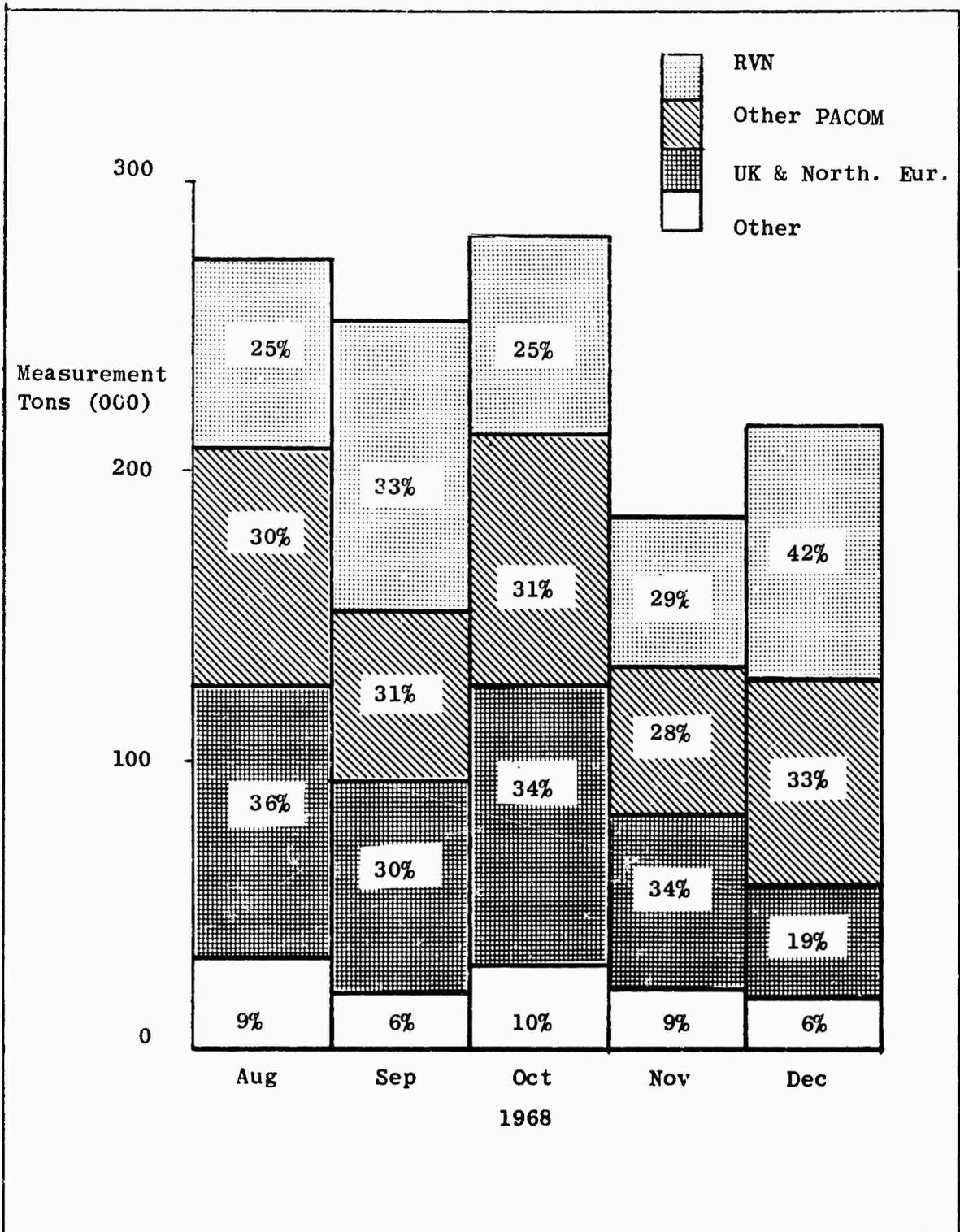
The distribution of DOD worldwide intermodal container shipments by major oversea area for the last five months of 1968 is shown in Figure 2-6. RVN shipments in three of the five months were less than 30 percent of the total, with shipments to Europe and the United Kingdom exceeding those to Vietnam during the same three months. Shipments to Pacific locations other than RVN approximated those to Vietnam, although it is probable that much of this tonnage was in indirect support of the Vietnam effort.

Of all intermodal container shipments in 1968, both commercial and DOD to the European continent, approximately 11 percent were government sponsored, while 56 percent of all container movements to the Pacific areas (including Alaska, Hawaii, Japan, the Bonins, the Ryukyus, Korea, Taiwan, the Philippines and Vietnam) were government sponsored.

While the major increase in outbound DOD intermodal container traffic has occurred from west coast ports, there has also been a significant increase from east coast ports since 1966, (Figure 2-7).

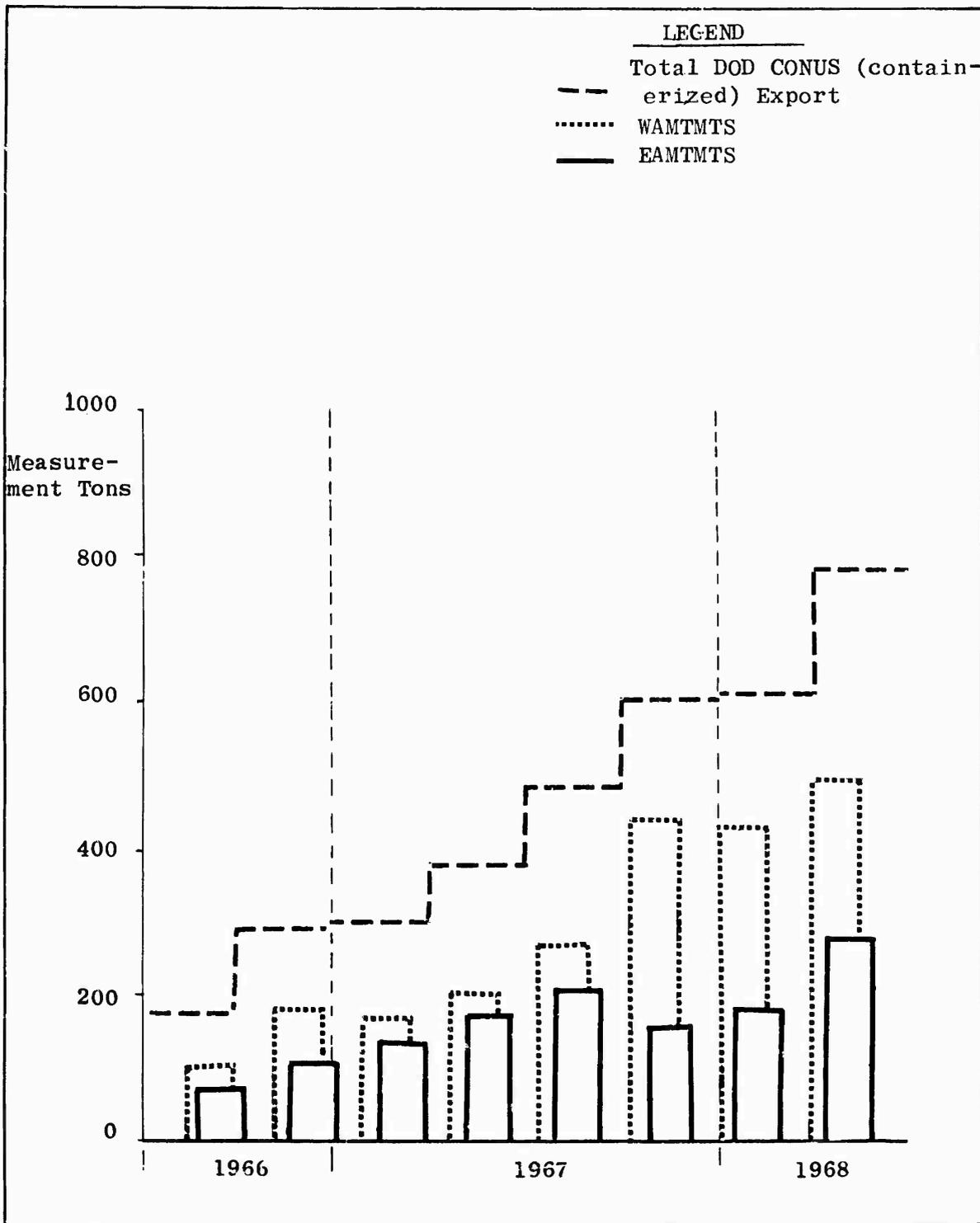
Potential Container Application

In spite of the major increases in the use of containerization by DOD, only a small percentage of the total potential containerizable cargo is being shipped in containers. It is estimated that during the period 1965-1968, an additional 6 million MT per year of cargo destined for oversea areas other than RVN could have been containerized. This represents approximately 300,000 20' equivalent container loads per year. On the assumption that the average container turnaround time is 60 days, or about six turnarounds per year, 50,000 20' equivalent containers would be required to move this cargo.



Source: WAMTMTS Container Traffic Report 1966-1968

Figure 2-6 DOD Containerized Cargo Movements
by Area of Consignment



Source: MTMTS Container Traffic Reports 1966-1968

Figure 2-7 DOD Containerized Cargo Movements.
Worldwide by CONUS Area of Origin

CONTAINER IMPACT ON VIETNAM PORT FACILITIES

Concept of Operation

During the 1965-1968 time frame, the majority of cargo shipped to Vietnam was in the break-bulk mode. In the early part of the period, ships were actually used as warehouses pending the completion of construction and the availability of manpower for unloading. There was also, at that time, considerable selective unloading, which resulted in partially loaded ships remaining in Vietnam harbors for considerable periods of time. Since storage and staging areas in the ports were extremely limited, the unloaded cargo was immediately cleared from the port, and in many cases, port clearance capability determined the unloading rate. During this period, most unloading, except at Saigon, was performed by over-the-beach operations requiring the use of barges, lighters and smaller utility craft.

As deep-draft berths were constructed, the over-the-beach operations were reduced considerably at the major ports. However, it was and is still necessary to use over-the-beach operations in support of a number of small ports. This involves a transshipment operation at a major port, followed by a coastal operation using barges, lighters, LCMs, LSTs, LCUs, YFUs and roll-on/roll-off ships. The major port at Da Nang is heavily involved in such coastal operations.

Large numbers of Conex containers were used in cargo shipment during the period, and although they were handled as individual breakbulk shipments, their use did, in practice, increase the throughput capacity of the ports. This increase resulted primarily from the reduction in the number of lifts required in ship unloading and the amount of handling required for port clearance after unloading. The fact that the

Conex weight capacity is tailored to the lifting capacity of the ship booms and port materials handling equipment, and that no special equipment, either on the ship or in the port, was required for its loading or discharge was of particular value in the early period of operation.

Some cargo was moved into Vietnam ports during this same period in the RO/RO mode. This mode accounted for considerable tonnages, particularly in the case of unit moves, where a high percentage of the measurement tonnage of unit equipment can be moved by the roll-on/roll-off method. This results in a considerable increase in port capacity in those cases where the roll-off is actually practicable. However, there were many instances where cargo capable of being handled in the roll-on/roll-off mode, was loaded into conventional breakbulk ships and had to be unloaded by breakbulk methods.

In 1967, the use of commercial intermodal containers was introduced into Vietnam. This operation, and the terms of the contract, are covered in greater detail elsewhere in this report. The containers were moved on container-ships belonging to and operated by the contractor with both self-sustaining and non-self-sustaining ships used. Service from CONUS was limited to two major ports, Cam Ranh Bay and Da Nang. Non-self-sustaining ships, which require port facilities capable of loading and unloading the ship, were used for shipments from CONUS to Cam Ranh Bay, with containers destined for the major ports of Saigon and Qui Nhon transshipped from Cam Ranh Bay on small self-sustaining ships which have a self-loading and unloading capability. Shipments from CONUS to Da Nang were made by self-sustaining ships. Thus, in 1968, all container shipments from CONUS were made to two Vietnam ports, only one of which had a container unloading capability, with service to other ports made by transshipment.

The use of these large (8' wide x 8'6" high x 35' long) containers resulted in a major increase in port throughput capacity, a major reduction of ship turnaround time in the RVN port and consequently, a major reduction in throughput time and costs from consignor to consignee. Additional savings accrued from the reduction in the use of National Defense Reserve Fleet breakbulk ships which would have been required had containerships and containers not been used. They were not used in LOTS operations in Vietnam, but the use of 20' containers and even conceivably of 35' containers, in LOTS operations should be considered to be feasible, dependent upon the conditions of beach surface and beach egress.

If maximum containerization had been possible in Vietnam during the time period studied, many of the problems of port congestion, port clearance and ship delay noted above could have been alleviated through the increase in port throughput capacity provided by the containers. Additionally, the highly expensive and ineffective use of ships as floating storage facilities could also have been avoided.

LOTS operations would have been considerably facilitated through the capacity to land containers on chassis in the roll-on/roll-off mode, thus avoiding the requirement for double handling in the breakbulk mode.

In summary, the impact of full containerization on port facilities during the 1965-1968 period in Vietnam would have greatly increased flexibility and throughput capacity of ports. It would have decreased ship turnaround time, port congestion, demurrage costs, manpower required to move cargo at and through ports, and the number of berths required for port operations. A detailed discussion of the impact of full containerization on port facilities for Vietnam follows.

1/ See Chap. 4 for a discussion of port and other facility requirements of a maximum container operation.

Port Construction

In early 1965, the only deep-draft port of consequence in South Vietnam was Saigon, where a limited number of suitable berths were in existence, but were used principally for commercial cargo. Navigational difficulties and restrictions in the Saigon River also limited the size of the ships which could be handled in Saigon. There was a deep-draft pier at Cam Ranh Bay, but its limitations in length and width made it only marginally useful for transoceanic military cargo.

The limited capacity of the Saigon and Cam Ranh Bay ports, and more importantly, the lack of secure land transportation routes, made it necessary to support U.S. Forces from a number of shallow-draft ports on the Vietnam coast. These ports were operated initially using shallow-draft vessels and over-the-beach operations. Steps were taken to provide additional deep-draft berths, but concurrent with the construction period, a rapid buildup of forces occurred. The large quantities of cargo arriving in Vietnam waters to support the buildup, and the lack of adequate unloading facilities at the ports, combined to produce the problems of port congestion described above.

The only DeLong Pier in the defense reserve was moved to Vietnam and installed at Cam Ranh Bay.^{1/} New piers (DeLong and Reeves) were obtained and installed, and construction of permanent piers and wharves was also undertaken. By 1968, a total of 34 deep-draft berths were available for the discharge of military cargo, and the earlier problems of port congestion had been resolved. (See Table 2-7.)

^{1/} Working paper on Ports and Terminals prepared by Team 2 of Task Force E (Lt. Col. Danzeisen).

PORT	NO. OF BERTHS
Saigon	10*
Cam Ranh Bay	10
Qui Nhon	4
Da Nang	6
Vung Tau	2
Vung Ro	2
Total	34

*Number available for military cargo

Table 2-7. Deep-Draft Berths Available in RVN for Military Use, End CY 1968 ^{1/}

The ports of Saigon, Cam Ranh Bay, Qui Nhon and Da Nang are major Vietnam ports. The other two ports are minor ports receiving most of their cargo by transshipment from the major ports.

As shown earlier, maximum containerization of cargo at the 1968 level of activity would have required approximately 400,000 container landings per year (20' container equivalents). Therefore, each of the four major ports would have required a capability to handle at least 100,000 container landings per year.

In a complete container operation these containers would be expected to arrive on large non-self-sustaining containerships. Therefore, each major port would have required a container-ship unloading pier approximately 90' x 700', equipped with two suitable gantry cranes, and a reinforced decking, or their equivalent. Such a pier actually provides two deep-draft berths but during the unloading of a containership, the opposite berth is not, in practice, usable for RO/RO or breakbulk cargo. It can, however, be used for transfer of containers from the arriving non-self-sustaining ship to smaller ships for intracoastal transfer. The pier would also require RO/RO interface units to handle cargo arriving in the RO/RO mode.

^{1/} Working Paper on Ports and Terminals prepared by Team 2 of Task Force E (Lt. Col. Danzisen).

A second pier would also have been required at one of the major ports, probably at Cam Ranh Bay, to handle shipments destined for Saigon. The restrictions on navigation in the Saigon River, noted above, do not permit movement of large containerships to the port of Saigon. Consequently, shipments to Saigon would have had to be unloaded at Cam Ranh Bay and transshipped by smaller vessels to the Saigon port. Therefore, the four major ports would actually require five such piers.

The two minor ports of Vung Ro and Vung Tau would each have required a DeLong type A pier, providing slightly smaller berths. These ports would have been served by shuttling selfsustaining containerships from the major ports.

It will be seen that this permits the DCD to use a combination of commercially available non-selfsustaining ships in combination with a number of smaller selfsustaining ships as a minimum cost, high frequency of delivery, highly flexible, low vulnerability system.

During the construction period, port capacity could have been increased considerably by the use of mobile port facilities, such as container gantry ships. These ships substitute a ship-board for a shore-based crane for containership unloading, thus forming a bridge between the containership and the shore. For example, it has been estimated that the capacity of the port of Da Nang could be increased by 55 percent in the first 90 days and by 130 percent in the second 90 days by the use of such a container gantry ship.^{1/}

Field observations by APJ personnel indicate that the average cycle time for unloading a container from a full containership and reloading an empty container in its place is approximately three minutes. The large non-selfsustaining containerships presently in service carry approximately

^{1/} Navy briefing to JLRB on "Integrated Sealift"

1,000 20' container equivalents. Allowing a 20 percent loss for partial cycles when starting or completing any segment of the ship, and based on the use of two gantries, results in a requirement for 30 hours of pier occupancy per ship. After allowances for docking and undocking, a total pier occupancy time of 1.5 days per ship is required. The average annual ship arrivals per pier would be 100, each carrying 1,000 20' container equivalents, occupying the pier for 150 days per year, leaving 215 pier days, or 430 berth days per year for breakbulk and RO/RO ship handling, and as an allowance for typhoons or other interruptions.

During 1965-1968, the maximum surface cargo movement to RVN occurred in 1968, when the total cargo movement, including CONUS and other Pacific area shipments was 12,113,000 MT. About 33% (4,000,000 MT) is non-containerizable, consisting of 28 percent RO/RO and 5 percent breakbulk cargo. The small amount of breakbulk cargo could be loaded on flat bed trailers or similar wheeled carriers and moved in the RO/RO mode; this would permit shipment of the remaining 33 percent of cargo by the RO/RO mode. Therefore, each major pier should have a capability to unload slightly more than 1,000,000 MT of RO/RO cargo per year.

Experience with the RO/RO ship ADMIRAL WILLIAM M. CALLAGHAN indicates that such a ship can discharge an average load of about 15,000 MT in one day.^{1/} Allowing for docking and undocking time, such a ship would require 1.5 days of berth occupancy. Thus, the 1,000,000 MT of RO/RO cargo would require approximately 67 ship arrivals and 100 days of berth occupancy.

^{1/} ADMIRAL CALLAGHAN Cost and Performance Evaluation", USAMC, June 1969

This leaves a total of 330 berth days per year at each pier for contingencies such as typhoons, less than average performance, or shipments in excess of the average amounts considered in this analysis.

Stated in another way, such a pier would have an annual capacity of approximately 5.4 million MT at a mix of 67 percent containerized and 33 percent RO/RO cargo. The utilization rate in 1968 would have been approximately 56 percent.

In summary, the entire cargo volume to Vietnam during the peak year of 1968 could have been handled by 14 deep-draft berths, had maximum containerization been possible. This would have required the installation of five large, gantry-equipped piers at the four major ports and two DeLong Type A piers or equivalent at the two minor ports. Deep-draft berth requirements would have totaled 14, a reduction of 20 from the 34 berths actually furnished in Vietnam. (See Table 2-8.)

PORT	ACTUAL	MAXIMUM CONTAINERIZATION OPERATION
Saigon	10*	2
Cam Ranh Bay	10	4**
Qui Nhon	4	2
Da Nang	6	2
Vung Tau	?	2
Vung Ro	2	2
Total	34	14

* Available for military cargo

** Two used for transshipment to Saigon

Table 2-8. Deep-Draft Berth Requirements
In Vietnam

IMPACT ON OTHER RVN FACILITY REQUIREMENTS

Any assessment of lessons learned in Vietnam must include consideration of the potential value of containers for purposes other than cargo movement. The following discussion considers the usage of containers as replacements for certain types of facilities in Vietnam, and the implications which can be drawn from that experience as to the potential value of containers in such applications.

In actual practice in Vietnam, the use of containers for other than cargo movement purposes was limited to the Conex. The terms of the contract with the commercial seavan operator prohibited the use of his privately owned intermodal containers for other than cargo carrying purposes, except for the short periods of time when the container was waiting to be unloaded, between the time of its arrival at a port and the departure of the next commercial containership from that port. The only exception to this, still within the concept of cargo movement, was the reuse of containers for intra-theater shipments.

Covered Storage

The most common use of the Conex for purposes other than cargo movement was as a substitute for covered storage facilities.

It has been stated that the presence of the Conex container in Vietnam provided an additional six million square feet of covered storage space.^{1/} (This figure implies that approximately 90 percent of the Conexs which

^{1/} Briefing to JLRB by Lt. Col. Mattingly, Chief, Containerization Branch, Transportation Division, Directorate of Distribution and Transportation, Army Materiel Command, August 1969

remained in Vietnam were used for covered storage, an estimate considered reasonably accurate as of any given point in time.)

Measurements of Conex shipments indicate an average content of six MT, or 240 cubic feet per container, approximately 80 percent cube utilization. Since the Conex has a floor area of 48.6 square feet, this represents an average height usage of 5 feet, or 5 cubic feet of stored material per square foot of container floor area.

Although in the average warehouse in Vietnam material can be stacked to a height of 12 feet (3 48 inch-pallets) the effective height per square foot of total space is, of course, much lower. Aisles, passageways, and receiving and shipping areas reduce the number of square feet available for stacking. The normal cycles of issue and receipt result in many stacks of less than maximum height, and bins and pallets not completely filled. Based on observations of warehouses in Vietnam, an average of six effective cubic feet of storage per square foot of warehouse space is a reasonable basis for storage space and cost calculations. As the Conex containers had an effective cubic foot factor of five (or 5/6 ths that of the warehouses) the six million square feet of covered storage space provided by the Conexs is approximately equivalent to five million square feet of warehouse storage.

As of September 1968, approximately seven million square feet^{1/} of covered storage facilities had been constructed in Vietnam, excluding the cubic equivalent contributed by Conex containers described above. Therefore, it appears that the Conex provided about 5/7ths, or 42 percent of the covered storage cubic content actually used in Vietnam, as of September 1968.

1/ U.S. Navy Vietnam Construction Report, September 1968

The Conexs used for covered storage were, to a large extent, used for storage of Class II supplies. Very little of this space was used for Class I supplies, probably due to the small capacity of any one Conex when compared to the considerable bulk of Class I supplies stored at a depot having a ration breakdown function. Much of the Class I volume in Vietnam was placed in open storage, resulting in high losses and high manpower requirements for reclamation, repacking and repackaging.1/

Table 2-9 is an analysis of supplies shipped to Vietnam in the 1966-1968 period. For each category shown, the first column indicates the percent of the total tonnage represented by that category. The next column indicates the estimated percentage of that category which requires covered storage, although covered storage was not necessarily always provided in Vietnam. This is particularly true of Class I non-perishables, as noted above and to cement, which was generally held in open storage, usually under tarps, and on which losses as high as 50 percent have been reported in Vietnam.2/

- 1/ Memorandum for Record, Subject "Notes of Conference - Report of Packaging Team to Southeast Asia", Part of Tab D to letter, Hqs. AMC to JLRB, 18 November 1969, Subject "Conex and Packaging Information Request"
- 2/ Research paper "The Containerization Revolution - Its Military Impact" by Major Richard E. Stephenson, TC, 12 April 1968.

Supply Class	% of Total I/ Tonnage	% Requiring Cov'd Stor	% Block Container Storable	% Requiring Reefer	% Open Stor or Through Ship
I Non-Perishable	7.38	100	95	-	-
I Perishable	3.27	-	-	100	-
II Cloth'g, Ind'l Equip	17.49	100	25	-	-
III Packaged FOL	.75	20	20	-	80
IV Const Matl (excl. Cement)	20.01	-	-	-	100
IV Cement	.60	100	100	-	-
V Ammo	13.50	10	10	-	90
VI Sales Items	8.99	95	95	5	-
VII Major End Items	24.97	-	-	-	100
VIII Medical Materiel	.23	90	10	10	-
IX Repair Parts	2.20	98	10	2	-
X Non-Mil Programs	.61	-	-	-	100
% of Total Tonnage (MT)	100	37.9	(22.3)	3.8	58.3

Container storable as percent of covered storage - 59%

I/ "Total Tonnages to Vietnam, 1966-1968 - All Services", furnished JLRB Task Force E by MIMIS

Table 2-9. Storage Requirements of Vietnam Cargo

The next column indicates the estimated percent of cargo in each category which can be stored in a block configuration comparable to the type of storage which would be provided in a container. The next column indicates the percent of each category requiring refrigerated storage. The final column indicates the balance of cargo in each category which is either shipped directly to the user or which can be safely stored in the open.

From the data in Table 2-9, it can be seen that 37.9 percent of the total cargo received required covered storage and that 22.3 percent (or 59 percent of the 37.9 percent requiring covered storage) was cargo which could be stored in a block configuration. This permits rapid location and issue of the item, precludes any requirement for re-warehousing and binning, and shipment of the entire container intact, when a requirement is sufficiently large. Thus, this type of cargo could have arrived in intermodal containers and remained in the same containers for the storage period. Therefore, containers providing block stowage could have provided 59 percent of the total 10,677,000 square feet of covered storage space required as of 1 September 1968, or 6,300,000 square feet.

As noted earlier in this chapter, an equivalent 8' x 8' x 20' dry container has a capacity of 1,050 cubic feet. Average utilization of these containers in cargo distribution is 80 percent or 840 cubic feet.

The use of such containers as storage facilities would decrease the utilization, but only to a small extent. It is estimated that approximately 50 percent of the containers could be shipped directly to the user intact. Additionally, under the block stowage concept, issues would only be

made from one of the several containers containing a given commodity, until the container is emptied and replaced. Therefore, it is believed that approximately a 75 percent utilization rate is a reasonable estimate for containers used for covered storage, or an average of 768 cubic feet per container. It should also be noted that the improved locating and issuing rates noted above, coupled with the improved turnaround rate for containerships can be expected to reduce the total amount of supplies needed in theater for support of operations.

The 6,300,000 square feet of container-furnished covered storage space discussed above, using an average storage height of six feet, converts to 37,800,000 cubic feet of storage space. Based on 768 cubic feet of storage per container, a total of approximately 49,200 20' equivalent container would have met the square foot covered storage requirement.

Use of containers for this purpose would have had many advantages. They could have provided immediate response to the storage requirement. They are mobile and could have provided such support where needed. Losses resulting from open storage of some commodities could have been avoided. Pilferage, estimated in a DOD study at 15% to 20% in Vietnam could have been largely avoided.^{1/}

This use of the container as covered storage is also consistent with the comments of knowledgeable people circularized by the JLRB. For example, Secretary Ignatius has stated that further reliance be placed on prefabs. Containers qualify as prefabs in this sense, and have the added advantage that they do not constitute additional cargo shipped to the theater.

^{1/} "Analysis of Containerships and Other Fast Turn-Around Shipping Systems for RVN Logistic Operations", OASD (SA), 8 March 1966

General William W. Momyer, USAF, Commander TAC, stated in part that construction never matches operational requirements and that there is a need for portable facilities that can be erected and disassembled by troops in a few hours, and a need for hard shelters which are simple to erect, easy to maintain and can be moved as required. Containers constitute portable facilities and hard shelters which require no erection or disassembly, and can be moved as required.

General Mark E. Bradley, USAF (Ret), commented that in early RVN operations, huge quantities of supplies arrived with little or no place to store them, resulting in tremendous damage and loss, and little or no inventory control or knowledge. He recommended a reserve of quickly erectable, light buildings to house supplies. Certainly, the container, in its role of covered storage, would meet his recommendations, and directly address the solution of the problems he mentions.

Mr. V. F. Caputo, Director of Transportation and Warehousing Policy, OASD, has recommended the use of portable storage facilities, such as inflatable warehouses that can be stored with mobilization reserves. Containers would provide the recommended portable storage facilities and would also have the added advantage that they do not constitute additional cargo to be shipped to the theater.

Reefer Storage

The Conex is not intended as a refrigerated container, although there were occasional instances in Vietnam where both freeze and chill cargo was placed in Conexs for short periods of time. However, the lack of insulation in these containers makes them unsuitable for maintenance of low temperatures.

Commercial reefer type Seavan containers were provided but, under the provisions of the contract, could only be used for storage purposes for brief periods of time between their arrival and the sailing of the next ship. This resulted in a requirement for unloading refrigerated cargo from the Seavan container into a fixed reefer storage facility and later reloading it into another vehicle for delivery to the user. It is understood that there were some individual instances of issue of supplies to troops from commercial reefer Seavans, but this was not common practice. In these instances, containers were normally loaded with wholesale lots of a single commodity.

Both fixed reefer facilities and the walk-in reefer boxes available at some locations, were subject to considerable deterioration in the unfavorable climate of Vietnam. This would not be true to the same extent in the case of reefer containers, used for storage until emptied and then replaced and rotated with inspection and maintenance performed in CONUS.

A high percentage of the refrigerated cargo shipped to Vietnam arrived in breakbulk reefer ships. In most cases, this cargo was cleared from the port by dropping sling loads onto flat bed trailers. These were hauled to the reefer storage facility of the nearby depot, where immediate manual unloading into the reefer facility was required. In many cases, the unloading of reefer ships had to be interrupted to close the reefer holds and bring them back to suitable temperatures, thus tending to accumulate further demurrage charges on the ships.

Reefer ships were also used intentionally as holding storage space for reefer cargo, pending the availability of refrigerated storage,

deliberately incurring ship demurrage as an alternative to spoiled cargo. During 1968, two ships were normally used for this reefer storage purpose, one at Qui Nhon and one at Vung Tau (a third ship shuttled from port to port distributing reefer cargo). 1/

One of these ships was a commercial ship at a per diem rate of \$4,045.00.2/ The other ship was a USNS reefer ship and, of course, was not charged at a specific per diem rate. However, since it was the same type ship (R1) as the commercial ship, it can be assumed that the actual cost to MSTIS was approximately the same. In addition to these ships, two reefer barges were used for storage purposes at Da Nang.

It must be assumed that the use of these ships and barges provided cold storage capacity approximately equal to the difference between the stated requirement, as of 1 September 1968, for 2,728,000 cubic feet and the actual construction as of that date, of 1,964,000 cubic feet.3/

Intermodal containers designed for movement of refrigerated cargo provide a means for refrigerated storage. Table 2-9 shows that approximately 3.8 percent of the total cargo shipped to Vietnam in 1965-1968 required refrigerated storage, and thus, all of this cargo could have been stored in refrigerated containers. The use of containers for this

1/ MSTIS, M-3 (Ops), Cargo/Passenger Division

2/ COMSTS Instruction 7600.3D, 7 August 1967, "Ship Per Diem Rates".

3/ U.S. Navy Vietnam Construction Report, September 1968.

purpose would thus have eliminated the necessity for construction of the 1,964,000 cubic feet of storage actually built, and the costly use of ships and barges for refrigerated storage.

The use of such containers as storage facilities does not imply the permanent stationing of such containers in an area. The container proceeds through the distribution cycle in the usual manner, but is so packed that it can be used as a storage facility. When it has been issued intact to a user or its load has been drawn down, through issue, to a point where its continued retention is uneconomical, it is replaced by another container load through normal resupply action. The original container is then returned, with suitable retrograde cargo, where required, to CONUS. The net effect is an extension of the time cycle for the container to and from the theater.

The 8' x 8' x 20' reefer container has a capacity of 800 cubic feet and an average utilization of 660 cubic feet, or slightly more than 80 percent. Because of the high incidence of direct shipment of complete containerloads to the user, as discussed previously in this Chapter, it is estimated that 80 percent (or 640 cubic feet) utilization could readily be attained, when the containers are used as reefer storage facilities.

The stated requirement for 2,728,000 cubic feet of reefer storage space, using 640 cubic feet of storage per container, could have been met by the use of approximately 4,300 reefer containers.

Construction Modules

Field observation in Vietnam and all reports of such field observations indicate that the potential uses of Conex containers are limited only by the imagination of the soldier. In addition to its functions as a cargo carrier and as covered and binned storage facilities, the Conex has been used for all types of administrative buildings, including kitchens, mess halls, orderly rooms, mail rooms, post exchanges, command posts, jails and sentry boxes at depots, motor pools, and many others.

Although the percentage of the total Conex population which eventuated in such uses in lieu of construction is comparatively small, their value to the troops in the field is considerable. It is certain, that, had larger containers been available, they would have been used for these same purposes and for others for which the Conex was not suitable.

The commercial Seavan containers used in Vietnam were not available for such uses due to their commercial ownership and the contractual requirement for rapid turnaround. If the principle of maximum containerization had been possible in this period in Vietnam, much greater advantage could have been taken of their potential as construction modules. Government-owned containers, after completion of their cargo-carrying mission, could have met much of the administrative building requirements in the theater. They could also have met the requirements stated by Major General Bruce E. Kendall, USA, of the ICAF, who noted: "There are new military needs: better military type containers, more and better mobile vans, logistic type mobile computers, portable military warehouses or combination warehouse-containers..." The use of containers as construction modules would be responsive to these requirements, i.e., for mobile vans, housing mobile computers and communications equipment. When necessary, modification kits could be issued for specific uses.

SUPPLY AND DEPLOYMENT APPLICATIONS

Binned Storage

One of the most successful and popular uses of Conex containers in Vietnam was their application to binned storage, almost literally the movement of a section of a depot from CONUS to Vietnam.

This type of operation was first used as a general purpose pre-binned deployment depot section in connection with the supply of aviation parts. Prior to the Vietnam Era this use was pioneered by Lt. Gen. W. B. Bunker, who assigned a Conex fitted with replaceable common hardware to Army aviation units in the mid 50's. The U.S. Army Aviation Systems Command at St. Louis calculated small parts requirements for the support of Army aviation from its demand data files. The Sharpe Army Depot then installed wooden bins inside Conexs, filled the bins with parts, inserted the necessary blocking and bracing and inclosed in each Conex a set of punch cards which identified the items, their number and their specific location within the Conex. On arrival at the support unit in Vietnam, the punch cards were inserted in the stock record files of the unit. Thus, the parts were not handled from the time they were placed in the bin at Sharpe Army Depot until they were actually issued for use in Vietnam.^{1/}

This concept was later expanded to other types of repair parts. In the establishment of the depot at Cam Ranh Bay, 53,000 line items of spare parts were shipped from Tooele and Sacramento Army Depots in this manner, using 70 van type trailers and over 400 Conex containers.^{1/}

^{1/} Research paper, "The Containerization Revolution - Its Military Impact" by Major Richard E. Stephenson, TC, dated 12 April 1968.

From August 1965, through August 1968, approximately 6,000 Conex containers were binned in this manner.^{1/} It was not possible to extend the concept of binned storage to the commercial Seavan containers due to the contractual requirement for their rapid turnaround.

Under the concept of maximum containerization, the use of intermodal containers for binned storage has the potential for considerable amplification. The availability of larger containers, particularly in the 20' size, would have made this concept practicable for a wider range of repair parts, particularly parts of the larger sizes. Additionally, the use of such containers, pre-loaded and ready for immediate deployment, would be of major assistance in meeting contingency requirements calling for rapid unit moves.

Unit Supply

The term "unit supply" as used in this section pertains to the shipment of supplies from a CONUS source directly to a using unit in the theater of operations. It does not include those items which are shipped to a theater depot or a support unit and later issued from stock to a using unit.

The concept of containerization for unit supply has had little application in Vietnam. Conex containers were occasionally used for such supply functions, but were more often used to replenish stocks of General Support and Direct Support organizations. Commercial Seavans were normally loaded either for wholesale distribution,

^{1/} Tab G to letter, Hqs. AMC to JLRB, 18 November 1969, Subject "Conex and Packaging Information Request"

such as a container load of a single commodity, or by consolidation of smaller shipments, requiring a breakbulk operation at some point in the theater.

Maximum advantage of containerization can be taken only if containers are used to the greatest extent possible and practicable for unit supply, thus avoiding the handling, unloading, reloading and rehandling involved in the breakbulk concept or the wholesale to retail concept.

The most obvious area for payoff in this reduction of handling is that of rations. The current concept has been to ship wholesale lots of each ration component to a ration breakdown function in the theater of operations, or to a Naval Supply Base. Each organization served by that depot or supply base is then issued rations in retail quantities, based on morning report strength.

This is a costly process in terms of both manpower and loss of valuable rations. If the CONUS ration depots, instead of shipping wholesale lots of single commodities, were to ship containerized loads, each bearing a given number of man days of a specific type of ration, to a ration depot for holding and reissue intact to using units, this rehandling, package breaking, and loss could be eliminated. The frequency of issue of container loads to units would be keyed to morning report strength.

The same procedure can be applied to refrigerated rations of both the chilled and freeze type, separately. This concept is consonant with the principles of TASTA 70, in that it increases the mobility of the using unit and also contributes to the mobility of supporting units, such as a ration depot, by providing an inventory on wheels, capable of immediate movement.

Knowledgeable personnel performing studies in the supply area have stated: "In the field of Army logistics, a great asset would be the use of methods which will permit cargo to be unitized according to user requirements in rear areas for direct scheduled supply in the appropriate quantities for direct delivery to the user, passing through his supporting installation for the purpose of stockage level control (i.e., avoid overages or deficits)"^{1/} The concept discussed above meets this requirement completely in the Class I supply area.

It has been estimated that the daily subsistence requirements for an infantry battalion of 830 men amount to 4,410 pounds and occupy 150 cubic feet.^{1/} On this basis, a 20 foot container loaded to 75 percent of its cube capacity would hold approximately 4,350 man days of rations and the infantry battalion would require one such container every five days.

Thus, an organization of a given size might be issued a container of non-perishables every five days, a container of chilled rations every eight days and a container of freeze rations every 11 days. The unit would use the containers as its ration storage facilities, and when required, the container could be moved with the unit. When the container was emptied, it would be returned and replaced by a full container. There will, of course, be certain small items of rations, for example, certain spices, which are used slowly and at irregular rates, which would be issued to using organizations on a retail basis.

^{1/} Draft "Containerization of Supplies to an Infantry Battalion", USACDC Supply Agency, Ft. Lee, Va., April 1969

This method of operation would involve a major conceptual change in the handling of military rations. Maximum advantage of the principle of containerization of rations would require removal of the ration breakdown function from the theater of operations and placing it in CONUS. The elimination of handling, rehandling and sorting of rations in the field, and the considerable loss of such supplies attendant on this field handling and open storage, would far more than compensate for the added workload at DSA depots, where this function could be performed in a much more efficient environment.

Packaged POL could also be containerized for issue direct to using units. Usage factors have been developed sufficiently well to be applicable to broad categories of equipment so that standard container loads could be developed for the more common types of using organizations. In this case, it might not even be necessary to include a factor of time, but merely of product mix, so that an infantry battalion might request a type X container once each week or 10 days, an armored battalion might request a type Y container every 5 days, and a truck company might request a type Z container every 7 days, with the time element varying in accordance with the degree of activity of the individual unit. As was true in the case of rations, the organization could use the container as its storage point for these commodities, and empty containers would be retrograded as they are replaced by full containers.

A parallel concept could be used for the supply of ammunition. Small arms ammunition could be furnished in containers bearing a mix of types of ammunition, based on the small arms authorization and usage in the type of unit involved. Heavier ammunition would undoubtedly be supplied in

containers bearing a single caliber and type. In the case of unfixed ammunition, projectiles and propellant charges would be separately containerized. Each container would hold some specified number of days or fraction of days of supply for a battery using that caliber and type of ammunition. Used brass would be placed in empty containers and they would then be exchanged for full containers.

As noted earlier, the actual containers used for ammunition supply would normally be the 8' x 4' x 20' containers for very high density ammunition, and the 8' x 8' x 20' container for all other types.

The routine supply of repair parts to organizational level maintenance would probably not be done in containers. However, this principle could be used in the supply of parts to Direct Support, General Support and Depot level maintenance organizations, in the form of binned storage, as discussed above.

A parallel to the current method of handling rations exists in the forwarding of exchange sales items. At the present time, these are shipped to PX depots in Vietnam where they are unloaded and stored, reloaded and shipped to individual sales stores, with considerable loss, pilferage and spoilage occurring during the process. The Army Air Force Exchange System does not operate CONUS depots, and there are, therefore, no existing locations comparable to DSA depots which could absorb the function of receiving wholesale shipments from vendors and containerizing them for through delivery to PXs. However, this function could be performed much more efficiently by the establishment of AAFES consolidation points in the vicinity of CONUS water ports or in conjunction

with MTMTS consolidation points, thus eliminating the considerable handling costs and loss which result from performing this function in a theater depot.

The general concept of maximum containerization and direct movement of unit supplies to the user is agreed to by most logisticians. For example, General William W. Momyer, USAF, Commander TAC, has stated that logistics should be oriented in the direction of producer to consumer and elimination of the middle man.

Lt. General Harvey Fischer, USA Ret., has recommended that a study be made of how the container can be used to make a major jump in the supply of an oversea theater.

Mr. V. F. Caputo, Director of Transportation and Warehousing Policy, OASD, has recommended the use of balanced supplies in containers, such as mixtures of subsistence to form rations, or mixtures of packaged oils and lubricants to support truck or tank companies.

The concepts discussed above appear to present practical and feasible ways by which the ultimate goal of rapid movement of supplies to the user with a minimum of handling and delay enroute could have been met in Vietnam. This concept was considered in arriving at the estimate of 50 percent direct shipment to user included in the preceding discussion of containers as storage facilities.

Unit Moves

The movement of any military unit involves the loading, movement and unloading of its TOE equipment, its PLL, its ASL, (where applicable) and additionally, the many unspecified items which any such organization accumulates. This amounts to a large number of items, most of them small, except for major end items of equipment. Consequently, containerization is an ideal

solution for such moves, whether they be from CONUS to Vietnam, or shorter moves within Vietnam, and whether they be by surface or air.

This fact was recognized early in the Vietnam era and in the period from 1966 through 1968, a total of 21,039 Conex containers were used in connection with unit deployment.^{1/} There is no doubt that this number would have been considerably greater if more of these containers had been available. There is no record of the actual number of these containers which stayed with the individual units after completion of deployment, but observations in the field indicate that the natural reluctance of a military unit to give up what it considers to be a good thing also extends to Conex containers.

The larger commercial Seavan containers were not used in connection with unit moves, due to the fast turnaround requirement for those containers, and the fact that Seavans were introduced after build-up was largely completed.

Under the concept of maximum containerization, the use of Conex containers for unit moves would be largely replaced by larger intermodal containers. This would eliminate the requirement for a small unit to maintain the capability to handle Conex containers on and off organizational vehicles and consequently, would increase the mobility of the unit. Additionally, the larger intermodal container would permit better packing, fewer loads and greater mobility. The advantages of binned, prepacked containers to support unit deployments has been noted above.

^{1/} Tab A to letter, Hqs. AMC to JLRB, 18 November 1969, Subject "Conex and Packaging Information Request"

CHAPTER 3

**IMPACT OF CONTAINERIZATION ON
RESOURCE REQUIREMENTS AND LOGISTIC EFFECTIVENESS**

CHAPTER 3

IMPACT OF CONTAINERIZATION ON RESOURCE REQUIREMENTS AND LOGISTIC EFFECTIVENESS

ISSUES

As shown in Chapter 2, the use of intermodal containers, had they been available, to meet all container applications in Vietnam, including cargo distribution, facility construction and internal supply and deployment operations, would have had a major impact on these operations. In Chapter 2, the impact was quantified in physical terms, e.g., tonnages, numbers of piers, square footage of storage space, and similar measurements.

In this Chapter, the measurements shown in Chapter 2 are related to their impact on resource requirements and logistic effectiveness. The following issues are discussed, related to Vietnam operations in the 1965-1968 time period, under a total containerization concept:

1. Cargo distribution operating costs
2. Cargo handling costs
3. Cost avoidance in areas of pipeline reduction, port and storage facilities
4. Manpower requirements in port, depot and construction operations
5. Time requirements for full deployment.

COST IMPACT

Shipping and Handling

Shipping Costs

An analysis of the total costs of moving cargo from west coast CONUS consignors to Vietnam consignees^{1/} produced a cost of \$75.26 per MT for breakbulk cargo, \$60.70 for containerized cargo, a difference of \$14.45 per MT. In both cases, these costs include both equipment amortization and profit elements.

Shipments from CONUS to Vietnam during the 1965 to 1968 period totalled approximately 29.4 million MT. In addition, during the same time period, approximately 6.2 million MT were shipped to Vietnam from various Pacific sources, for a total of 35.6 million MT (see Table 3-1).

Year	(000) MEASUREMENT TONS		
	CONUS to RVN*	Pacific to RVN**	Total
1965	2,682	416	3,098
1966	6,800	1,945	8,745
1967	9,713	1,960	11,673
1968	10,238	1,874	12,112
Total	29,433	6,195	35,628

* See Table 2-1

** MSTs data to JLRB "PACOM Tonnage to RVN"

Table 3-1 Total Cargo Movements to RVN,
Measurement Tons

As has been previously indicated, approximately 67 percent, or 23.87 million MT, of this cargo was containerizable, including ammunition and rations. Application of

^{1/} APJ Report 589-3, "Milvan Pilot Operation Evaluation, Pre-Introduction Phase".

the cost differential of \$14.45 per MT to this 23.87 million MT produces a saving of \$345.0 million which could have been achieved with maximum containerization.^{1/}

This estimate is considered conservative. Loss, damage, pilferage and losses in storage in Vietnam have not been considered, although these losses would have been largely avoided had maximum containerization been possible.

It is generally recognized that containerization reduces loss, damage and pilferage. The extent of reduction, however, is difficult to quantify. To some extent, such losses relate to the type and value of cargo, ports of origin and destination, and the size and weight of the shipping unit. Various estimates have been made, some of which are:

1. 1.5 percent of value of PX goods shipped to Vietnam were pilfered under breakbulk shipments, none under Seavan shipments.^{2/}
2. Elimination of pilferage reduces costs from 10 percent (Forbes, April 1, 1968) to 20 percent (Engineering, April 15, 1966). Insurance rates have also decreased as a result of containerization. For example, Matson offers a 25 percent insurance savings in its Hawaiian trade (Hunter, 1968).
- .. Breakage can be reduced by 50 percent by properly packing containers. In 1965, Matson's claim ratio (percent of claim payments to revenue) was 3.2 percent for non-containerized cargo, 1.16 percent for containerized cargo. In 1966, the ratios were 2.51 percent and 1.04 percent respectively, (Traffic World, March 30 1968).

^{1/} Although comparative costs of breakbulk and containerized cargo movements from PACOM ports are not available, it is assumed that the savings from container movements approximate those measured for CONUS west coast port shipments. Therefore, the \$14.45 per MT factor has been applied to total cargo movements to RVN

^{2/} "The Containerization Revolution - Its Military Impacts", Major Richard E. Stephenson, April 1968

4. Claims reduced from \$.43 per ton to \$.06 per ton for containerized shipments from the United Kingdom to Australia. Reductions from \$.60 to \$.06 per ton on shipments from Australia to the United Kingdom (Container News, November 1969).
5. Marine executives state that, with conventional handling, the loss and damage factor for some cargo, notably small, high value items, may exceed 9 percent. Shipping lines with long experience in containerization have reduced this to less than one percent.^{1/}

Because of the unavailability of specific data on loss and pilferage related to Vietnam operations, no estimated saving in dollars has been included in this chapter as resulting from reduction in these costs. It is apparent, however, that savings do exist and the cost differential per ton shown above is highly conservative. A pilferage and loss estimate of 15 percent to 20 percent has been used in a DOD study.^{2/}

Handling Costs

The figures quoted above include, for both modes of transportation, the handling costs at the RVN port and at the RVN depot; and therefore, reflect any potential savings in those costs which were attained under the circumstances actually prevailing in Vietnam.

^{1/} Regular Common Carriers Report on Containerization in International and Domestic Commerce, Regular Common Carriers Conference of the American Trucking Association, Inc.

^{2/} "Analysis of Containerships and Other Fast Turn-Around Shipping Systems for RVN Logistic Operations", OASD (SA), 8 March 1966.

However, had maximum containerization been possible, additional savings could have been made, primarily in the cost of cargo handling in the RVN depot. In the operation which actually occurred, all cargo arriving at the depot, whether breakbulk or containerized, was unloaded and placed in storage. Most of this cargo was later loaded onto trucks or semi-trailers for delivery to the user. Under a concept of maximum containerization, a considerable proportion of the containerized cargo arriving at an RVN depot would have remained in the containers. Additionally, a major portion of the cargo which was in storage in containers could have been shipped to the user in the same containers, without the necessity for a reloading operation.

In Table 2-9, it was shown that approximately 26.1 percent of the total cargo shipped to Vietnam (22.3 percent dry and 3.8 percent reefer) could have been stored in its container in lieu of covered storage. This, in effect, means that half of the cargo (13.0 percent) would have avoided one handling, as it would have been loaded directly from the container to the truck making delivery, rather than from container to warehouse to truck. The remaining 13.0 percent would have avoided both depot loading and unloading, as it moved directly to the user in the container.

A study of time and costs in Vietnam^{1/} indicates that the average cost for unloading cargo at the RVN depot and placing it in storage was \$1.98 per ST; removal from the warehouse and loading costs are comparable. The cargo on which these costs were based averaged 3.1 MT per ST, or a possible saving in cargo handling of \$.64 per MT for cargo stored, or stored and issued in containers. As the 13.0 percent of cargo stored in containers and loaded onto trucks saved one handling and the remaining 13.0 percent shipped directly to the user saved 2 handlings, total

1/ APJ 589-3, "Milvan Pilot Operation Evaluation - Pre-Introduction Phase"

saving can be computed by multiplying 13.0 percent x 3 handlings x \$.64 per MT for the 35.6 million MT or \$8.9 million. (Table 3-1.)

COST AVOIDANCES

Pipeline Reduction

Pipeline investment is a function of pipeline days and the value of a day's supply. An analysis of shipments from the West Coast to Vietnam during the third quarter, CY 68,^{1/} excluding Bulk POL^{2/} showed an average time of 68.7 days for breakbulk and 55.4 days for containerized cargo, a saving of 13.3 days from containerization.

A day of Army sponsored cargo for support of Vietnam in 1968, excluding Class I and Bulk POL^{2/}, is estimated at \$11.9 million.^{3/} Army sponsored cargo in 1967-1968 constituted 69.5% of total cargo to Vietnam^{4/}; thus, the total value of a day of pipeline of these supplies for all Services would have been \$17.1 million. Class I supplies shipped to all Services amounted to an additional \$1.2 million per day for a total \$18.3 million cost per day of pipeline. About 67% or \$12.3 million of the total would have been containerizable. The 13.3 days saving for containerized cargo would thus have reduced the pipeline by \$163.6 million. However, Sea-Land shipments in 1968 accounted for approximately 10% of total containerizable movements, and cost avoidance of \$16.4 million is assumed to have been made on these shipments. The balance of \$147.2 million represents an additional pipeline saving which could have been obtained with full containerization.

- 1/ APJ Report 589-3 "Milvan Pilot Operation Evaluation-Pre-Introduction Phase."
- 2/ Bulk POL has been excluded from the analysis as it is not carried in the container or breakbulk mode.
- 3/ DCSLOG, DA estimate, excluding rations and medical material. These were costed at \$.37 per lb. for rations, \$5.00 per lb. for medical maintenance.
- 4/ MSTs Report, RVN Sealift Digest, Dec. 1968

Facility Construction

Derivation of Cost Factors

The determination of cost factors related to military operations is always difficult. Variances in reporting categories, reporting time and scope of elements covered produce an inherent uncertainty in reported values.

These difficulties become even greater when the use of troop labor is involved. The costs of troop support (housing, messing, medical and other) make the true cost of troop labor difficult to assess.

While contract construction costs are more clearly identifiable, the expenditures paid to the contractor also do not represent the total cost to the government of the contract operation. Costs of contract negotiation, administration, quality control and inspection, security clearance, security administration and control, and other monitoring and contract support activities are required for all contracts. Additionally, in the case of military construction, as with many other contracts in Vietnam, third country national employees were used to some extent. Although the burden of support of these employees is primarily the responsibility of the contractor, some logistical support requirements are inevitably transmitted to the government by the nature of the relationship of the parties concerned.

Data used in this study to establish military construction cost factors were obtained from the Status of Military Construction Report, RCS, DDI&L (M) 915, dated 28 February 1969. This report provides cost data related to construction accomplished by contract, troop labor and in total for both types of construction activity.

Costs shown in this report related to troop construction do not include any military personnel pay and related costs, nor do they include transportation, handling and storage costs for construction material shipped to Vietnam. Consequently, these stated costs are much lower than the actual costs incurred. Contractor costs represent amounts paid to the contractor for total performance under the contract. The contractor was responsible for acquisition, transportation, storage and handling of material as well as the recruitment, pay and administration of personnel and provision of most overhead support. Therefore, contract costs shown in the report included all of these elements plus any profits accruing from the operation.^{1/}

Cost data for troop construction included in the "915" report were excluded from consideration in establishing construction cost factors because of the major understatement of the true costs described above. Contract costs, however, contain most costs associated with military construction, and are thus considered to provide a conservative basis for estimating true construction costs. As noted in 1967 by the MACV Director of Construction, BG Raymond, the total real cost, from all sources of funds, of a project accomplished by troops was at least equal to the cost of a like project accomplished by contractor construction forces.^{2/} When it is considered that about 80% of the contractor work force consisted of local national employees with an average monthly pay of \$150^{1/}, this is not hard to understand. Accordingly, contract construction costs were selected as the basis for deriving construction cost factors used in this study.

^{1/} Discussion with Commander George Plante, JLRB, 8 Jan.1970

^{2/} Raymond, D.A., BG, USA, "Observations on the Construction Program", RVN, 1 Oct.1965-1 June 1967 (U), (Confidential), cited in Draft NR 1, JLRB Official Working Paper, "Development and Construction of Advance Base Facilities", by Capt. Harry Stevens, 8 December 1969.

Port Facilities

The port facilities actually provided in Vietnam consisted of berthing space (piers and wharves), dredging and harbor operation buildings.

A conservative and realistic cost factor for port facility construction was difficult to establish. The "915" report, cited earlier, showed widely varying contract costs for construction at the major ports of Cam Ranh Bay, Da Nang, and Qui Nhon, ranging from \$1,125 per MT per day of capacity at Cam Ranh Bay to nearly \$11,000 per MT per day of capacity at Da Nang. Costs included all waterfront operating facilities, including piers, hardstands, transient sheds, staging areas, ramps etc., but excluded dredging and harbor operation buildings.

Because of the wide variance in costs at the three areas, it was decided to use the reported contract cost for total waterfront construction at all ports in Vietnam, which (at \$3,408 per MT per day of capacity) was lower than the cost factor associated with two of the three port areas discussed above, and lower than the cost for the three port areas combined.

It was also decided that an approximately 7% increase in this cost factor to account for the cost of government support over and above direct contract costs, which is applied to warehouse construction costs, (see below) would not be applied to port construction costs.

The purpose in deriving port construction costs in Vietnam is to provide cost factors as a basis for comparison of these costs with those involved in mobile pier installations under a full containership concept. No attempt has been made to establish all the

costs of port construction, many of which are difficult to quantify. Therefore, cost factors used are limited to those major costs which are relevant to the comparison and which can be quantified with reasonable accuracy under both the conventional and mobile pier construction concepts. Where cost elements under both concepts appear to be approximately equal or where cost differences appear to be relatively minor and difficult to quantify, they have been excluded.

Accordingly, the costs of pier operating facilities, hardstand, dredging and harbor operational facilities have not been considered for either concept. It is probable that some overall saving would accrue in these areas under a full containerization concept, with fewer berths required. However, such savings would not be proportional to the reduction in berths and to insure that estimated savings shown are valid and conservative, these cost elements have been excluded.

As noted above, the \$3,408 per MT per day of capacity cost for waterfront construction does not include dredging nor harbor operational facilities. It is believed that the cost of transient sheds (a minimal number are used at ports in Vietnam because of the proximity of depots), hardstand and other pier operating facilities would not exceed the approximately 7% of contract costs considered to be a reasonable estimate of the cost of government support to contractors described above. Consequently, the \$3,408 per MT per day of capacity is considered a reasonable estimate of the average cost of conventional pier construction (less hardstand and operating facilities) in Vietnam during the period covered.

A total of 51,700 MT per day capacity was provided, resulting in a total cost for permanent type berth construction of approximately \$176 million. In addition, the procurement, delivery and installation cost of the DeLong pier facilities amounted to an expenditure

of approximately \$60 million,^{1/} making a total of \$236 million for the installation of piers and wharves.

Of this expenditure, only the DeLong piers represent any recoverability value. It is estimated that the cost of delivery and installation was approximately 20% of the total contract cost, with the remaining 80% representing material, and that the cost of removal and relocation would be approximately equal to that for delivery and installation.^{1/} Assuming that an additional 10% of the original value would be spent for replacement and repair of unserviceable components, the total investment in the piers, including removal, relocation and repair would be \$78 million, with a recoverability of \$48 million. The net cost of the DeLong piers would thus be \$30 million, producing a net cost of \$206 million for all deep draft berths.

Under the concept of maximum containerization described previously, the requirements for deep draft berthing could have been met by providing 5 large mobile piers and two smaller units. The cost of these units can be estimated from known costs of the DeLong pier installations, which averaged \$73 per square foot.^{2/} The two gantries required for each

^{1/} Mr. Jefferson Feagin, Directorate of Requirements, HQ USAMC, Project Officer for AMC for DeLong pier project.

^{2/} While this report bases its cost calculation for mobile piers on DeLong pier costs, it should be noted that an alternative portable pier, which was prefabricated and deployed in sections to Da Nang, was the Reeves pier, which is stated to be less costly than the DeLong pier. To the extent that lower cost alternatives than DeLong piers are developed and available, the projected savings in port facility construction costs would be increased.

of the large piers cost \$2.8 million and the reinforced decking \$150,000.^{1/} The two RO/RO interface ramps, at approximately 5,000 square feet, are estimated to cost approximately 20% higher per square foot than the \$73 price for the large piers, resulting in a grand total cost of about \$8.4 million per large pier installation.

The two smaller DeLong piers at the minor ports, also estimated at \$73 per square foot, would come to \$3.5 million each. The total cost for the total pier installation (less dredging, waterfront and harbor operating facilities) would thus have amounted to approximately \$49 million under a complete containerization concept. Based on recovery factors discussed above, this installation would have a recoverability value estimated at approximately 50% of the total investment resulting in a net cost of approximately \$25 million. The difference between the \$206 million actual net cost and the \$25 million cost possible under complete containerization indicates a potential cost avoidance of \$181 million.

A corollary to the cost avoidance in construction of port facilities is that of avoidance of demurrage charges because of elimination of port congestion. The port facilities described could have been fully operational by the beginning of 1967, if not earlier. Therefore, it can be considered that the MSTs delay billings for 1967 and 1968 could have been avoided. These amounted to a total of \$89.7 million.^{2/} This estimate is also considered conservative since it includes only payments to commercially operated vessels and does not include internal MSTs expenses incurred in delays of the nucleus fleet.

^{1/} Mr. Jefferson Feagin, Directorate of Requirements, HQ USAMC, Project Officer for AMC for DeLong pier project.

^{2/} MSTs Briefing to JLRB

Covered Storage

All reports of Vietnam operations and field observations are replete with examples of the shortage of covered storage in Vietnam, particularly during the rapid buildup period. Expensive supplies were piled wherever there was available open space, resulting in much loss of materiel and many instances of supplies on hand which could not fulfill their mission. Equipment was deadlined for parts actually on hand in the theater, but not identified or locatable. Many requisitions were unnecessarily duplicated, resulting in eventual overstockage. In addition, ships were often used as floating warehouses, resulting in severe port congestion and unnecessarily high demurrage charges.

As of 1 September 1968, the stated requirement for covered storage in Vietnam was 10,677,000 square feet, whereas the actual amount constructed, including both contract and troop labor construction, amounted to 6,940,000 square feet.^{1/} The average cost of construction of this covered storage was \$15.00 per square foot.^{2/}

The cost per square foot of covered storage construction was based on contract costs shown in the "915" report, for reasons discussed earlier. Contract cost data for two areas in Vietnam, in which major projects involving construction of a complete facility, had taken place were selected for analysis. It was felt that areas with smaller construction projects, or areas where projects included both new construction and renovation and modification of existing facilities, might tend to be anomalous, with deviations resulting from local conditions (or even the lesser scale of the projects) and produce distorted costs. The costs at Cam Ranh Bay and Da Nang, where covered storage construction amounted to over 20 percent of the total

^{1/} Navy Vietnam Construction Report, September 1968

^{2/} DOD RCS 915, 28 February 1969

square footage and nearly 25 percent of the total cost of all covered storage construction in Vietnam, were selected as the basis for construction unit cost in Vietnam.

Contract costs at Da Nang were \$12.70 per square foot and at Cam Ranh Bay were \$15.32 per square foot, with an average cost for the two areas of about \$14.00 per square foot. This average was increased by approximately 7 percent to \$15.00 per square foot to account for the additional costs to the government for contract and contractor support requirements, described earlier, which are not represented by out-of-pocket payments to the contractor.

The \$15.00 per square foot cost factor selected falls between the cost factors related to Da Nang and Cam Ranh Bay construction and is considered a reasonable estimate of warehouse construction costs in Vietnam. It is considerably lower than that contained in AR 415-17, "Empirical Cost Estimates for Military Construction and Price Adjustment Factors", 3 June 1968, which provides a planning factor of \$22.50 per square foot for warehouse construction in Vietnam, outside the Saigon area.

If the principle of maximum containerization had been in use in Vietnam, a large percentage of the covered storage requirement could have been provided in the form of containers. This would have averted many of the difficulties cited above and at the same time, avoided a considerable portion of the covered storage cost.

It has been indicated in Table 2-9 that approximately 59 percent of the tonnage of supplies which require covered storage could have arrived in containers and remained in containers in storage. This represents 6,300,000 square feet, of the stated requirement of 10,677,000 square feet, leaving 4,377 million square feet of covered storage to be constructed. Provision of

6,300,000 square feet of container storage space, as stated in Chapter 2, would have required 49,200 20' equivalent containers.

Conventional covered storage, with its equivalent of six effective cubic feet of storage per square foot in Vietnam, has a resultant cost of \$2.50^{1/} per effective cubic foot of storage. None of this cost is recoverable, particularly after long exposure to Vietnamese climate.

At an estimated cost of \$1,500 per 20' container, (assuming 75 percent utilization, as stated in Chapter 2) the cost per effective cubic foot of container storage is about \$2.00. However, since these containers would not remain permanently in the storage but would be rotated to CONUS as they are emptied, and receive maintenance attention, they can be considered to be about 90 percent recoverable, resulting in a net cost of approximately \$.20 per effective cubic foot of storage. The relative maintenance costs of covered storage facilities and containers used in the storage mode are taken as equal.

The stated requirement of 10,677,000 square feet of storage represents a requirement for 64,000,000 effective cubic feet, of which 37.8 million could have been supplied by containers and 26.2 million by construction. At the \$2.50 cost, construction of the total required space would represent a total cost of \$160,000,000. If maximum containerization had been applied, construction of the 26.2 million effective cubic feet of conventional storage would have cost approximately \$65.5 million and the 37.8 million effective cubic feet provided by the containers would have had a net cost (considering recoverability) of approximately \$7.6 million, for a total of \$73.1 million.

^{1/} Effective cubic feet of storage considers space lost for aisles, passageways, and other reasons. The basis for this factor is provided on page 2-55.

This represents a potential cost avoidance of \$86.9 million, plus unknown millions of dollars saved in lost and spoiled cargo. (See Table 3-2 below).

Construction Alternatives	Cubic Foot (millions)	Cost Per Cubic Foot	Total Const. Cost (millions)
I <u>Conventional</u> Total Storage Space Required	64.0	2.50	160.0
II <u>Conventional & Container Storage</u> Container Capability (49,200 Ctrs.)	37.8	2.00	75.6
Less Recoverability (90%)		(1.80)	<u>68.0</u>
Net Ctr. Cost			7.6
Balance for Conventional Construction	26.2	2.50	<u>65.5</u>
<u>Total Net Cost</u>			73.1
<u>Savings Using Alternative II over Alternative I</u>			86.9

Table 3-2. Storage Facility Costs, Conventional Versus Container

Refrigerated Storage

As previously described, there was also considerable shortage of refrigerated storage space in Vietnam during the rapid buildup period. As of 1 September 1968, the stated requirement for such storage was 2,728,000 cubic feet. The actual amount constructed by both contract and troop construction at the same point in time was 1,964,000 cubic feet. During this buildup period, the deficit in cold storage facilities was principally made up by the use of reefer ships and barges.

If it had been possible to operate under the principle of maximum containerization during this period, the entire requirement for refrigerated storage facilities could have been provided by containers. The cargo, both chill and freeze, would have arrived in country in containers and remained in the containers in storage and in transit until the contents were actually used. This would have avoided the necessity for the reefer ships and reefer barges, and also for most of the walk-in cold boxes available in some locations.

The average cost of refrigerated storage constructed in Vietnam was \$11.00 per cubic foot.^{1/} Some of this would have been recoverable, particularly machinery items, at the cost of some additional labor. It is estimated that approximately 20% of the cost could be recovered, leaving a net cost of \$8.80 per cubic foot. Thus, construction of the required 2,728,000 cubic feet would have involved a net cost of approximately \$24 million.

A 20 foot refrigerated container is estimated to cost approximately \$3,000 (twice the cost of a dry cargo container) and to provide 640 cubic feet of refrigerated storage capacity. This is a cost of about \$4.70 per cubic foot. However, as with dry containers, these containers would be returned to CONUS as soon as emptied, and would receive maintenance attention. Therefore, they can be also considered to be 90% recoverable, resulting in a net cost of \$.47 per cubic foot. Thus, providing the same 2,728,000 cubic feet would require approximately 4,300 containers at a net cost (considering recoverability) of approximately \$1.3 million, resulting in a net cost avoidance of \$22.7 million.

^{1/} DOD RCS 915 28 Feb. 1969

Total Cost Impact

The total cost avoidance (beyond that actually accomplished) which could have been achieved had the principle of maximum containerization been possible in Vietnam, can be summarized as follows:

Item	Amount (\$ Millions)
<u>Recurring Costs (saved 1965-68)</u>	
Shipments (including port handling)	345.0
Depot Cargo Handling	<u>8.9</u>
Total Recurring	\$353.9
<u>Cost Avoidance (One-Time Savings)</u>	
Pipeline Reduction	147.2 (at 1968 level of activity)
Port facilities	181.0
Ship Delay Billings	89.7
Covered Storage	86.9
Refrigerated Storage	22.7
Total Cost Avoidance	\$ 527.5
Grand Total	\$881.4

Table 3-3. Potential Recurring Cost and Cost Avoidance Savings with Full Containerization in Support of Vietnam (1965-1968)

As stated earlier, the savings shown in Table 3-3 do not include any credit for reductions in loss and pilferage, although such reductions would surely have occurred.

As noted above, the recurring operating cost savings are accumulated over the 1965-1968 period of the study. Cargo movements to Vietnam in 1968 accounted for approximately 34% of total movements for the entire four year period. Therefore, at the 1968 level of activity, annual savings in operating costs could have been achieved as follows.

Item	Amount (\$ Millions)
Shipment (including port handling)	117.3
Depot Cargo Handling	<u>3.0</u>
Total	\$120.3

Table 3-4. Potential Annual Recurring Cost Savings with Full Containerization in Support of Vietnam. (1968 level of activity)

MANPOWER IMPACT

Maximum containerization in support of Vietnam during the period under study would have permitted considerable reduction in manpower requirements, particularly at ports and depots. The benefits from such a reduction are more than quantitative in nature. Much of the stevedoring work in RVN was performed by local and third country nationals. The use of third country nationals required the provision by the U.S. of some logistic support. Although in general the contractors performed satisfactorily, several factors related to the operation were distinctly unsatisfactory. Port operations were seriously hampered by strikes in Saigon in 1966, and riots in late 1967. Employees were generally

unavailable during holidays or periods of crisis, such as the Tet offensive. Therefore a decrease in dependence upon this type of support through manpower requirements reductions permits better control and greater flexibility in port operations. 1/

Ports

A study^{2/} of port operations in Vietnam found that the average stevedoring man hours required for the loading and discharge of breakbulk cargo was approximately .96 manhours per measurement ton, whereas the handling of containerized cargo required only .05 manhours per measurement ton, a difference of .91 manhours per measurement ton. Approximately 35.6 million measurement tons of cargo was shipped to Vietnam during the period under consideration of which 67 percent (23.87 million MT) was containerizable. Approximately 1.0 million measurement tons of the cargo was actually moved in intermodal containers. Application of this saving of .91 manhours per measurement ton to the 22.87 million MT of cargo which also could have been containerized, had containers been available, shows that a further reduction of 20.8 million manhours could have been achieved under these conditions.

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- 1/ Working paper on Ports and Terminals prepared by Team 2 of Task Force E (Lt. Col. Danzeisen)
2/ Briefing by USAF/AFLC Surface Container Study at USAF World Wide Transportation Conference, 23-25 Apr. 69, Lt. Col. E. Giannarelli, USAF.

Depots

Manpower savings which would have been possible in depot operations under a total containerization concept result from the elimination of unloading and handling into storage of those materials which could be stored in their containers and the handling and reloading of that same material for issue to the user, as discussed in Chapter 2. Also, as noted in Chapter 2, 26% of all cargo arriving in Vietnam could have been stored in its containers (22.3% dry cargo, 3.8% reefer cargo), thereby eliminating one handling and 50% of these container stored supplies could be issued to the user in the original container, thereby eliminating two handlings. The above factors produce a cargo handling saving equivalent to 39.0 percent of all incoming cargo.

Analysis of cargo handling time and costs^{1/} based on field data collected in Vietnam found that, at the depot at Cam Ranh Bay, the average performance in the unloading and moving into storage function was approximately 9.04 short tons per man day, which would not have been required had the handling requirement been eliminated. It is estimated that removal from storage and loading would result in like performance.

^{1/} APJ Report 589-3, "Milvan Pilot Operation Evaluation - Pre-Introduction Phase".

As noted above, cargo handling requirements would have been eliminated, under a container storage concept, for an amount equivalent to 39.0 percent of the approximately 18.0 million short tons of cargo received in Vietnam depots in the 1965-1968 time period, or 7.0 million short tons. The saving of a man-day for each 9.04 short tons received, when applied to the 7.0 million short tons, amounts to a total saving of approximately 775,000 man-days or 7,750,000 manhours which could have been achieved with full containerization.

Construction

It has been shown in Chapter 2 of this report that, had the principle of maximum containerization been possible in Vietnam, the requirements for construction for the handling and storing of cargo would have been considerably less. The principal areas involved would have been construction of covered storage, refrigerated storage and deep-draft berths.

Storage

It was estimated in Chapter 2 that the use of containers could have furnished approximately 6.3 million square feet of the total requirement for covered storage. Construction of covered storage in Vietnam required an average of approximately $.51\frac{1}{2}$ manhours per square foot. This represents a potential saving of approximately 3.2 million manhours, had containers been available and used for this purpose.

1/ U.S. Army Engineer Construction Agency, Vietnam, Planning Factors for Troop Construction, 31 August 1969.

The stated requirement for refrigerated storage in Vietnam as of 1 September 1968 was 2,728,000 cubic feet. This could all have been supplied by the use of reefer containers. Construction of refrigerated storage facilities in Vietnam required an average of .294 manhours per cubic foot 1/, representing a potential savings of approximately 800,000 manhours.

Berthing

In Table 2-7, it was indicated that a total of 34 deep draft berths were actually used in Vietnam. Five of these were existing commercial berths in Saigon. In 1964 the U.S. built, under the MAP program, a single deep water pier (2 berths) in Cam Ranh Bay to provide support for the Republic of Vietnam Armed Forces. Two more berths at Cam Ranh Bay became available in December 1965 with the installation of a mobile pier which was moved from reserve storage in Charleston, S.C. for that purpose. The remaining 25 berths were constructed subsequently. 2/

Had maximum containerization been possible, the port requirements could have been met by the use of 14 deep draft berths, as shown in Table 2-8. As the required number of berths existed in Saigon, the five additional berths constructed there would not have been required. The six berths constructed in Cam Ranh Bay after 1965 would also not have been required, nor would two of the four constructed at Qui Nhon and four of the six constructed at Da Nang. In total, a reduction in construction requirements of 17 deep water

1/ U.S. Army Engineering Construction Agency, Vietnam Planning Factors for Troop Construction, 31 August 1969.

2/ Danzeisen paper cited earlier.

berths could have been attained. Using an average length of 500 feet per berth indicates that approximately 8500 feet of berth construction could have been avoided. Construction of deep draft berths in Vietnam required an average of 36.5 manhours per foot of berth ^{1/} thus indicating a saving of slightly more than 300,000 man-hours which could have been obtained.

Total Manpower Impact

The potential savings in manpower which could have been achieved over the 1965-1968 period in Vietnam if the principle of maximum containerization had been possible, can be summarized as follows:

ITEM	MANHOURS (Millions)
Recurring Savings:	
Port Handling	20.8
Depot Handling	7.8
One-Time Savings:	
Covered Storage Constr.	3.2
Reefer Construction	.8
Deep-Draft Berths	.3
TOTAL	32.9

Table 3-5. Potential Manhour Savings with Full Containerization in Support of Vietnam (1965-1968)

^{1/} U.S. Army Engineering Construction Agency, Vietnam Planning Factors for Troop Construction, 31 August 1969.

As noted, the recurring savings shown above are accumulated over the four year period covered by the study. The 1968 level of activity resulted in 12.1 million MT of cargo being moved into Vietnam, or 34 percent of the four year total. Therefore, annual recurring manpower savings related to this level of activity amount to:

ITEM	MANHOURS (Millions)
Port Handling	7.1
Depot Handling	2.7
TOTAL	9.8

Table 3-6. Potential Annual Manhour Savings with Full Containerization in Support of Vietnam, 1963 Level

TIME IMPACT

The impact of containerization on operations in Vietnam as they actually occurred, has been discussed above, and an analysis has been made of the savings in manpower and cost that could have been obtained through maximum containerization. Maximum containerization would also have had a significant impact on the important resource of time.

The use of the Conex container undoubtedly resulted in some time savings in unloading ships in Vietnamese harbors, since it permitted a maximum single lift with ships gear. This characteristic reduces the number of lifts and handling required compared to a breakbulk operation of the same magnitude. However, it is doubtful if the use of Conexs had any real impact on the overall time schedule of operations in Vietnam.

The use of the commercial Seavan containers had a much greater effect on the port operations, particularly on the time required to unload cargo, and represented an important time saving in the movement of supplies from the CONUS origin to the RVN consignee. However, since this service was not fully operational until after the completion of the troop buildup in Vietnam, it is doubtful if the use of the Seavan containers actually contributed to any improvements in the early Vietnam buildup time table.

A major impact on the Vietnam operational buildup time table would have been possible had the concept of maximum containerization been feasible at that time, by permitting the early movement of cargo at a greatly accelerated rate. The troop buildup in Vietnam would have been completed at a much earlier date under a maximum containerization concept, assuming trained troops, adequate available supplies, sufficient containers and chassis, and adequate ports and required container handling equipment were available, and an installation program to provide necessary facilities and hardstand were promptly implemented.

To illustrate this, the following discussion presents an analysis of what could have been done under one given set of circumstances. There could, of course, have been many possible variations in equipment, particularly during the LOTS phase of a deployment operation.

The analysis covers the period from April 1965 through December 1966, when the major troop buildup in Vietnam took place. During that 21-month period, there was an increase of 310,000 men in the U.S. Forces in RVN, an average increase of about 15,000 men per month.

At the start of the period of buildup, there were slightly over 23,000 U.S. Forces in RVN. These were being supported by cargo unloaded at the existing commercial piers in Saigon. For the purposes of this study, it was assumed that these forces continued to be supported in the same manner, but that no other existing facilities were available and consequently, the buildup forces were supported by LOTS operations during the period necessary to construct additional deep-draft berth facilities.

An analysis of MSTTS tonnage records indicates that approximately 6 percent of the cargo shipped to RVN in 1965 (186,000 MT) was shipped during the first quarter. It can, therefore, be assumed that this cargo provided the support for the Forces in RVN prior to April 1965.

As indicated previously in this report, total surface tonnage shipped to Vietnam in 1965 amounted to 3,098,000 measurement tons, and in 1966 amounted to 8,746,000 tons, a total of 11,844,000 measurement tons for the two year period. Deducting the 6 percent of 1965 shipments leaves a total of 11,658,000 measurement tons for the 21-month buildup period.

A study made by the LCO LANT, in connection with a previous APJ project, showed that during the 12-month period from March 1966 through February 1967, the Eastern and Western Areas of MTMTS combined, shipped a total of 739,700 measurement tons of Army unit move cargo, or approximately 16 percent of the total Army-sponsored cargo shipped to Vietnam during the same period. Application of this percentage (assuming that it applies to unit moves of other Services) to the 11,658,000 tons moved in the 21-month period results in a figure of

1,865,000 measurement tons of unit move cargo during the 21-month period, or an average of 89,000 measurement tons per month. Since the troop buildup amounted to an average of 15,000 men per month, unit move cargo averaged 5.9 measurement tons per man. This is considerably less than the figure of 8.0 measurement tons per man shown in FM 101-10, but is considered reliable in view of actual figures on the move of the 1st Cavalry Division (Airmobile). Movement of that organization, with its 452 aircraft would be expected to produce a high average measurement ton requirement per man. The Division move to Vietnam, involving 15,050 men, and 98,103 measurement tons of cargo, including the aircraft, produced an average of 6.5 measurement tons per man.^{1/}

The tonnage of cargo unloaded in any time period, such as a month, consists of two distinct types. The first is unit move cargo accompanying the increment of men added to the force during that same time period. The second is the increment of support cargo, not only for the increment of men moved in but for the support of all troops currently in the area. Subtracting the 1,865,000 measurement tons of unit move cargo from the 11,658,000 measurement tons of total cargo unloaded during the 21-month period, leaves a net of 9,793,000 measurement tons of support cargo for support of forces in the theater and buildup of the theater reserve. The average support requirement for the 23,000 men in country was 62,000 measurement tons per month, therefore, over the 21-month period it would have amounted to 1,302,000 measurement tons, leaving 8,481,000 measurement tons for support of troops introduced to the theater during

^{1/} JLRB Task Force E Working Papers

the 21-month period. Based on a 15,000 man troop increment and the introduction of 21 increments over the 21-month period, the monthly support cargo increment is approximately 37,000 MT. Thus, for any one month, the tonnage required is equal to 89,000 MT times the troop increments moved in during that month, plus 37,000 MT for each of the cumulative number of troop increments introduced through that month.

Conversely, if the amount of tonnage capable of being moved in any given month is known, the number of troop increments which can be brought in and supported during a particular month while still supporting increments already in-country can be calculated.

It would not be reasonable to assume that there was large port capacity available nor that portable piers and accessories could be made instantly available. A buildup period during which cargo was moved into the country using over-the-beach operations would be required. However, if the necessary portable piers, gantry cranes and other accessory equipment had been in DOD stocks and strategically located, they could have been moved into position and erected in a period of approximately 90 days.

The JLRB has established a 60-day objective for mobile pier installations. The actual amount of time required will depend, to a great extent, on the amount of dredging required and the capability of available dredging equipment. The amount of dredging will obviously vary widely, depending on the port locations selected. In Vietnam, almost no dredging was required at Cam Ranh Bay and a large amount at Da Nang. For this analysis, therefore, the JLRB objective of 60 days has been given a 50% safety factor, and 90 days has been used as a mobile pier installation time factor, during which supplies would be unloaded over the shore.

It is necessary, for analysis purposes, that some assumption be made as to the types of equipment and methods of operation available during

that period, and these assumptions should be on the conservative side. Therefore, this analysis has adopted the assumption that self-sustaining container ships would arrive off-shore and unload their containerized cargo onto barges or lighters which would then be towed to shore. At shoreside, the containers would be lifted from the barge or lighter and placed on chassis by a mobile land-based crane. RO/RO cargo would arrive in large RO/RO ships comparable to the ADMIRAL WILLIAM M. CALLAGHAN and would unload their cargo onto Beach Discharge Lighters similar to the existing lighter LT. COLONEL JOHN U.D. PAGE. The Beach Discharge Lighters would move the RO/RO cargo to shore where it would be unloaded under its own power.

It is quite probable that the time consumed in an operation such as that just described could be considerably bettered by the use of LASH vessels, the SHEDS concept, or by use of container gantry ships. However, it is considered that in the case of this particular analysis, it is more reasonable to assume the use of more prosaic equipment, of which examples are presently in use.

A detailed analysis of the operations required in the situation described indicates that, during such a LOTS operation, a port throughput capacity of 35,000 measurement tons per month per port is practical. If these operations were performed at the four major RVN ports, this would produce a total off-loading capacity of 140,000 measurement tons per month. However, it is not considered practical to assume that this throughput capacity could be available immediately and continue through the 90-day period, while awaiting the construction of the portable piers. However, much equipment, such as the required large mobile crane and the original increment of

container chassis would have to be landed first and there would undoubtedly be much work required in the nature of beach and access preparation. Therefore, the total port throughput capacity of the four ports has been estimated at 1/3 of the calculated figure (947,000 MT) during the first month, 2/3rds (93,000 MT) during the second month and the full capacity (140,000 MT) during the third month.

It is recognized that problems of high tide, waves, open beaches, and rough weather modify capabilities at any one location. Allowance is made for this in the derating of the LOTS capability figures by attributing a capacity buildup well below that of even World War II. In the Vietnam context, these environmental problems were most pronounced at Da Nang, and were much less severe at Qui Nhon and Cam Ranh Bay and Saigon (an inland port).

As previously stated, the tonnage moved through the ports in any one month must be equal to 89,000 measurement tons times the number of troop increments landed during that month plus 37,000 measurement tons for each troop increment landed in that and all previous months. Thus, the 47,000 measurement tons capacity in the first month would result in moving ashore only .37 troop increments. During the second month, this would be increased to .63 troop increments and during the third month to .81 troop increments.

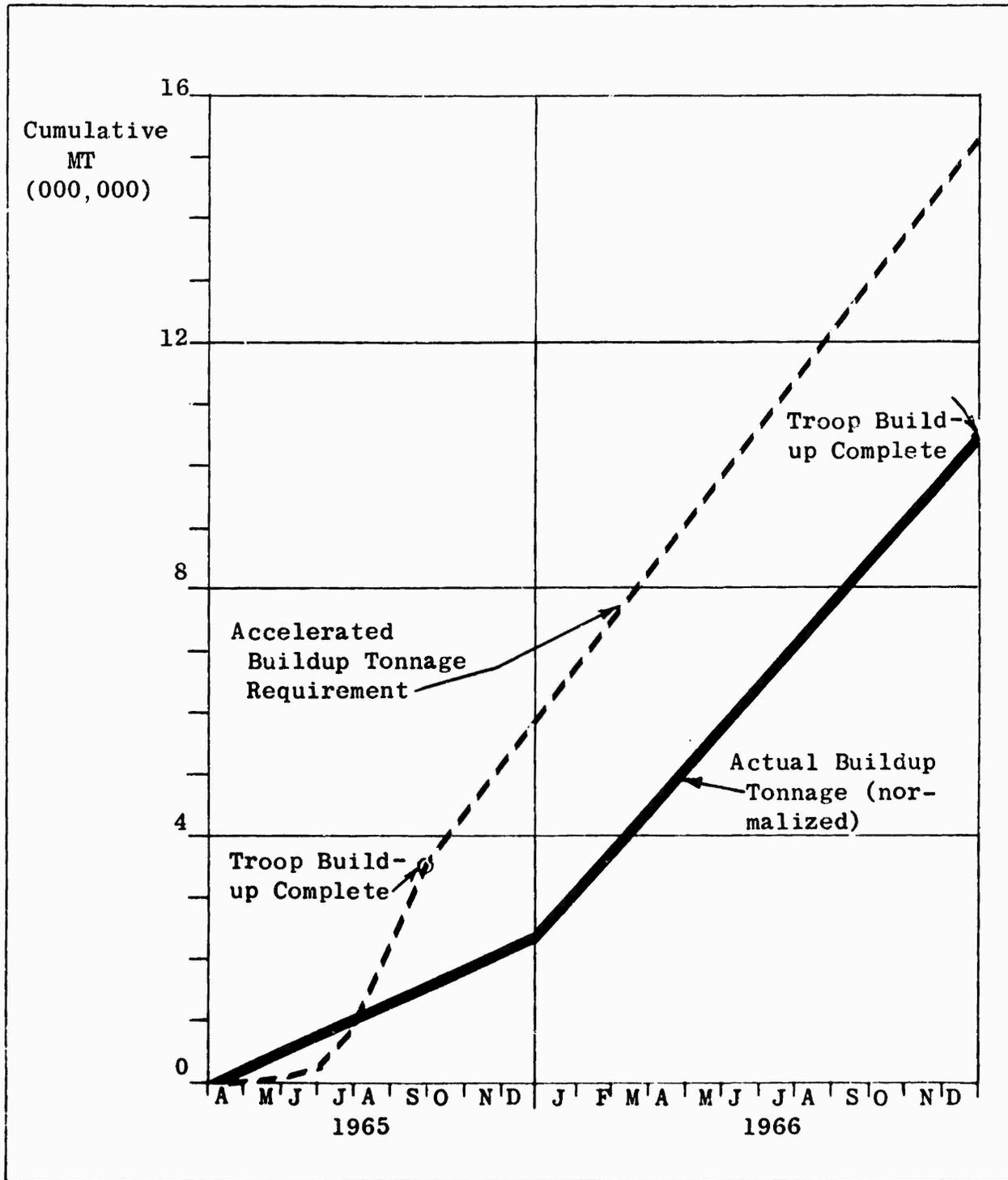
As previously stated, it is assumed in this analysis that at the end of the 90-day period, the portable piers would be operable. However, it is probable that in the 4th month of buildup, (the first month of pier operation), pier capacity would not be at 100 percent of actual capacity.

It has been previously established that the theoretical capacity of each major port, using DeLong Pier concepts, would be approximately 5.4 million measurement tons per year. However, it would not be practical to rate these ports at 100 percent of that capacity. A more realistic figure would be 4 million measurement tons per year, approximately 75 percent of theoretical capacity. This produces a total actual port throughput capacity in RVN of 16 million measurement tons per year or 1.333 million measurement tons per month.

Assuming the achievement of 50 percent of the realistic capacity for the first month of pier operations results in a throughput for that particular month of approximately 667,000 measurement tons. This would permit an input of 4.8 troop increments which, when added to those built up during the LOTS phase makes a cumulative total of 6.6 troop increments.

During the fifth and sixth months it is probable that the DeLong Piers would be able to operate at 100 percent of actual (not theoretical) capacity. This would result in the buildup during the fifth month of 8.6 troop increments and during the sixth month 6.1 troop increments, resulting in a cumulative total for the entire 6 month period of 21.3 troop increments. This is the total number actually built up during the 21-month period under investigation.

The presence of the completed troop buildup in Vietnam at the end of a 6 month period instead of a 21-month period would, of course, have resulted in higher support requirements, since the total number of man months in country would have been greater. However, these support increments, after the completion of the buildup



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Figure 3-1 RVN Troop Buildup Potential

in the 6 month period, would require only approximately 777,000 measurement tons per month, which is approximately 58 percent of the port throughput capacity. There would, of course, have been a continuing requirement for moving approximately 62,000 measurement tons per month through the existing facilities at Saigon for the support of the prior forces.

Figure 3-1 illustrates the comparative performance feasible under maximum containerization.

It will be noted that this structure of analysis is conservative, since the total throughput projected for the first three months is, in fact, less than that which actually occurred. It is only with the high performance characteristics of the containership/RO/RO support system in full operation that the rate of increase in port capacity exceeds that actually attained.

The analysis presented herein has been made in the concept of the Vietnam environment. No account has been taken of any necessity for assault landings, nor for major enemy reaction during the troop buildup and cargo landing phases. Also, the problems of accumulating the quantity of cargo containerships, containers and troop units ready for deployment in this condensed time frame are recognized. However, it is important to know that the potential to make a deployment of this magnitude exists under a total containerization concept.

In other parts of this report, container potential for use as covered and refrigerated storage, and as special facilities has been discussed. Obviously, the rapid buildup rate shown in Figure 3-1 would have required maximum use of these capabilities so that the logistic bottleneck would not simply have been transferred from the port to other portions of the logistic infrastructure.

During initial operations, especially under a buildup intensity as described here, containers would have been retained in the theater for somewhat longer periods than after the buildup was complete. The "depot-on-chassis" would greatly have favored early mobility operations.

The saving of no less than a year and three months in producing the complete Vietnam buildup has a significance which must be viewed in the light of the severe time constraints which political and other factors place on the duration of modern combat. With maximum containerization in being at all echelons, the combat Commander could have had approximately 61 percent more man years of troop availability.

CHAPTER 4

**EQUIPMENT AND FACILITY CHARACTERISTICS
DURING THE VIETNAM ERA**

CHAPTER 4

EQUIPMENT AND FACILITY CHARACTERISTICS DURING THE VIETNAM ERA

ISSUES

Containerization establishes new requirements for facilities and equipment, and their operations. The impact of these new requirements will increase as containerization continues its rapid growth.

In this Chapter, an analysis is made of the facility and equipment characteristics of the Vietnam era as the bases for policy recommendations. The following issues are discussed for each major category:

1. State-of-the-art
2. Capabilities and limitations
3. Impact of containerization
4. Problems related to military operations

OCEAN TRANSPORT

MSTS Fleet

The Military Sea Transportation Service (MSTS) is responsible for providing military sealift capability during times of peace and in times of national emergency. In order to accomplish its stated mission, MSTS has been granted the authority to maintain a "Nucleus Fleet" of Navy owned ships, to requisition and/or charter commercial shipping under certain circumstances and to reactivate ships of the National Defense Reserve Fleet and operate them under General Agency Agreement.

The Nucleus Fleet is a small group of mission-oriented Navy owned, MSTS administered and operated ships. The number

of ships in the MSTS Nucleus Fleet has varied from 59 in 1965 to 91 in 1968.

The MSTS also has at its disposal, the National Defense Reserve Fleet (NDRF). This fleet consists of inactive ships built during World War II, and not required by either the Maritime Fleet or the Military. During periods of national emergency, such as the Korean War and the Vietnam conflict, a number of these ships were reactivated by MSTS and operated by commercial shippers under General Agency Agreement. The fleet is composed of troop transport and combination passenger/cargo ships, ex-Naval auxiliaries, tankers, refrigerated ships, and dry cargo ships.

In 1965, the entire reserve fleet was at least 20 years of age with some ships as old as 26 years, most having been built during World War II.

Table 4-1, provides information on the dry cargo ships in the National Defense Reserve Fleet, as of 1 January 1967, of the 172 operating or being reactivated ships, 19 were in the process of reactivation and 153 were in operation. Most of the 172 were under General Agency Agreement (163) with only 9 under use agreement/bareboat charter.

Of the 804 ships laid up, nearly 65 percent are shown in poor/scrap condition, and another 29 percent in fair condition. Only slightly more than 6 percent or 53 of the 804 ships are shown as in good condition.^{1/}

^{1/} Source: 2nd Progress Report, Sealift Requirements Study; Office, Chief of Naval Operations, 20 February 1967

Type Ship	Operating or Being Reactivated	Laid Up			
		Good	Fair	Poor/ Scrap	Total Laid Up
C-3	4	0	0	5	5
Victory	136	20	0	8	28
Liberty	1	0	184	494	678
C-2	11	11	3	2	16
C-1A/B	15	22	9	8	39
R-2	2	0	0	0	0
C1-M-AV1 (Coastal)	3	0	38	0	38
Total	172	53	234	517	804

Source: 2nd Progress Report, Sealift Requirements Study,
Office, Chief of Naval Operations, 20 Feb. 1967

Table 4-1. Dry Cargo Ships in NDRF, 1 January 1967
(Useable Dry Cargo Ships)

It is MSTs's position that there are only approximately 200 dry cargo ships in the NDRF that have a genuine military sealift potential.^{1/} Experience with NDRF ships during the Vietnam era has indicated that these ships are of questionable economic value.

Military Sea Transportation Service also has the ability to requisition private ships, i.e., private ship owners may be required to charter or sell their ships to the United States government. This may be accomplished under provisions of the Merchant Marine Act of 1936 and by the declaration of the existence of a national emergency by the President of the United States.^{2/}

The decision to requisition private ships for military use is complicated by its impact upon U.S. commerce and national and international politics. In addition, it is felt that if the commercial ships are removed from their established trade routes, that segment of U.S. foreign trade carried on U.S. Flag ships will be transferred to foreign flag carriers and at the end of the national emergency, U.S. Flag carriers will be unable to regain their lost trade routes.

^{1/} MSTs presentation to the JLRB, 19 June 1969

^{2/} The same source states "The Deputy General Counsel of the DOD has expressed the opinion that requisitioning is permissible under the existing national emergency declared by President Truman on 16 December 1950. This emergency has not been terminated, nor have the war powers conferred by the Congress been rescinded." This power has not been exercised in the Vietnam conflict, as noted below.

In 1965, MSTS contingency plans were based on the assumption that requisitioning of commercial shipping would be authorized at the onset of hostilities.^{1/} Instead, the requirement was placed upon MSTS to transport men and supplies to the Republic of Vietnam under emergency conditions, without any concomitant authorization to undertake a mobilization of the U.S. Flag fleet. During that time, however, operations of subsidized cargo ships on the east coast of the United States were suspended because of a labor-management dispute. Since it was agreed by the parties involved that Department of Defense cargo would be moved regardless of strike conditions, a substantial number of the subsidized operators offered for charter some 54 ships to the Department of Defense, for periods of 3 to 6 months. Of the 54 ships, 34 were new, high speed, high capacity ships built since 1960.

In addition, MSTS with DOD approval, placed a request on the Maritime Administration to activate a number of ships from the National Defense Reserve Fleet. Of the NDRF ships activated, MSTS released 28 for scrapping. The performance of the remaining ships has been satisfactory, and 130 ships are expected to be returned to the

^{1/} MSTS presentation to the JLRB, 19 June 1969

Maritime Administration for preservation in the National Defense Reserve Fleet when Vietnam requirements permit. Table 4-2 presents the inventory of the MSTS controlled ships by year.

	MSTS Controlled Dry Ship Inventory*			
	1 Jan. 1965	1 Jan. 1966	1 Jan. 1967	1 Jan. 1968
Nucleus	59	76	84	91
GAA	2	61	153	151
Chartered	14	108	168	174
Total	75	245	405	416

* MSTS Presentation to JLRB, June 19, 1969

Table 4-2. MSTS Owned and Controlled Ships

In addition to problems in obtaining an adequate shipping capability, severe problems were also encountered in Vietnam port congestion, as noted earlier. These problems were particularly significant in the early days of the buildup. As late as FY 1967, approximately 31 ship years were lost as the result of port delays. By fiscal year 1968 this lost time factor had declined to 18 ship years. The delays resulted in additional costs to MSTS of 89.7 million dollars, over the two fiscal years.

Container-Carrying Ships

As one of the efforts to resolve the port congestion problems, the Office of the Secretary of Defense initiated a series of studies on the use of containerships and intermodal containers. As a result of these studies, Sea-Land Service Inc., contracted to provide this service for support of the Vietnam operation. (See Chapter 2.)

By the time Sea-Land operations to Vietnam were initiated, the use of containers and containerships in commercial operations had expanded rapidly. These facilities were also used by the Defense Department for movement of cargo to overseas areas other than Vietnam, although not on an exclusive contract basis.

The increase in container operations has resulted in the use of several different types of ships for container movement.

In general, there are five basic types of ships which carry containers:

1. Full containerships - single purpose ships with features for carrying containers in special cell structures. Most full containerships are of the non-selfsustaining type (with no ship's gear capable of loading or unloading the ship). Selfsustaining ships are also in use, but appear to be less economic.
2. Partial containerships - these ships carry containers in cell structures and can also carry other cargo including breakbulk, automobiles and other items.
3. Convertible containerships - Ships in which a hold may be used for either containers or other type cargo. An example is the Matson Lines, HAWAIIAN PRINCESS, which can carry containers from CONUS to Hawaii in all holds, and on the return trip use some holds for bulk sugar.
4. Limited containerships - These ships generally carry containers above deck and breakbulk cargo below deck.
5. Outsized cargo ships - these ships can carry wheeled vehicle equipment, containers and other items of outsized

cargo. Containers are handled either as a RO/RO vehicle, with the container mounted on the chassis, or as a large increment of breakbulk cargo. Examples are RO/RO ships and Seatrain vessels.

Full, partial and convertible containerhips all use cells for stacking containers in holds below deck. The main difference between the three types of containerhips is the number of holds used for container carrying. A full containerhip carries nothing but containers, while a partial containerhip has cell structures in some holds and carries breakbulk cargo in others. Breakbulk holds are not used for container movements. Convertible containerhips have cell structures in some holds and carry bulk cargo in others. When bulk holds are not being used in that mode, containers may be placed in them and with the use of special fittings may be stacked to a limited extent. No cell structure is installed in the bulk cargo holds.

Limited containerhips are breakbulk ships that can carry containers on the weather deck. These ships have small container capacity, (50 to 60 containers) and are not discussed in detail in this report.

Outsized cargo ships (including RO/RO ships and Seatrains) do not have cells for holding and stacking containers, but because of their large, unobstructed interior spaces can be used for transporting containers (normally on a chassis).

The following discussion deals with three major container-carrying categories of ships; containerhips (full, partial and convertible), RO/RO ships and Seatrains.

Containerships

The true containership is equipped to carry containers in cells and on weather decks by means of special structural arrangements. The containers are stacked one on top of the other in vertical cells in the hull and in vertical stacks on deck.

In loading below deck, the container is lowered into a cell vertically to its stowed position with no shifting in the horizontal plane. The reverse procedure is used for discharging. Both USASI and ISO standard containers are designed for stacking six high.^{1/} Containers are stored in cells with their length fore and aft in the vessel. One, two or three, or possibly more cell groups may be arranged in a group depending on the length of the hold between watertight bulkheads. Heavy steel frames separate cell groups to provide support for the cellular structure and structural rigidity to the vessel. Each group of cells is located under a hatch opening slightly larger than the cell group.

Containers are also stacked above deck on top of the hatch covers, which are fitted with container centering fittings to which containers are locked. This type of loading is possible because of the rigid box construction, which provides shelter to its contents and is easily lashed in place. The container in this role extends the carrying ability of the ship beyond the confines of the hull and compensates for the cubic losses sustained by the squaring off of the ship's hull. Containers have been stacked up to 4 high on deck as regular practice. However, above-deck heights are limited by seasonal weather and sea conditions.

^{1/} "Specifications for Cargo Containers", USASI MH 5.1-1965, "Draft ISO Recommendation No. 1496, Specifications and Testing of Series 1 Freight Containers", April 1969

The individual container cell is formed by four vertical guides located at each corner of the container stack running from the hatch combing down to the tank top. The guides have three functions:

1. To guide the containers to their stowed positions even though the vessel may be listing or the crane not perfectly centered over the cell (the list may not exceed 5°),
2. To place the corner posts of each container directly upon the corner posts of the container below,
3. To hold the container in its stacked position and absorb the horizontal forces imposed by the containers resulting from the motion of the vessel.

The cell guides are generally flared at the upper end to provide a centering guide for the containers entering the cell. The effectiveness of the cell guides in centering the container determines, to a great extent the cycle time for loading and unloading containers, as a deviation of more than 5° from the vertical, results in severe binding problems. The shipboard gantry crane on self-sustaining ships is most accurate in centering cargo for loading and unloading containers from cells. It can be accurately centered longitudinally with respect to the hatch and the deck rail, and need not be moved until an entire cell group has been discharged and loaded. As the crane is ship mounted, ship motion does not affect its relationship to the cells and makes loading into the cells easier.

Loading and offloading by shore based crane is somewhat more difficult. The greater height and pendulum length of these cranes makes the lift more susceptible to wind effects and more difficult to center accurately. Also, shore mounting makes the

centering of the lift more susceptible to ship motion. However, the transfer of containers from a rolling ship to a chassis on shore (or vice versa) presents problems regardless of whether the gantry is located on the ship or on the shore.

In spite of the advantages of a ship-based gantry crane described above, their longer cycle time, maintenance requirements and requirement for ship space make them less effective than shore-based gantries for containership loading and unloading. Additionally, above-deck stacking by ship-based cranes is limited to two tiers, as compared to four tiers for the shore-based cranes.

Unloading by a gantry crane mounted on another ship is entirely possible in calm waters, and could be a useful means of unloading non-self-sustaining ships when shore-based gantry cranes are not available. However, severe problems would be encountered in areas where ship motion occurred to any extent because of the criticality of the container centering in the cell.

Stacking above deck requires a satisfactory means for securing the containers in place to prevent toppling, shifting and rocking from the ship's motion. On the Sea-Land C4-J containership, this is accomplished by buttresses extending two container heights above the weather deck along each side of the ship, and the use of a metal lattice structure between the second and third tier and on top of the fourth tier. The buttresses or towers extend above the deck at the vessel's side between container groups and are braced inboard between stacked containers. After stacking the first two tiers of containers on the hatch covers in a conventional manner, a rectangular frame containing pyramid fittings

on its top and bottom surfaces is placed on top of the second tier. The pyramid fittings of the frame are engaged to the top corner fittings of the second tier and large self-centering pins on the outboard corners of the frame engage openings in the buttresses forward and aft of the stack on one side of the vessel. The third, and fourth tiers are then landed on the pyramid fittings of the frame and the second level of frames are added.

The first of the present generation of container ships were 6 converted C2-S-E1 ships built in 1942-1943 and converted to full container self-sustaining ships in 1957-1958, by Pan Atlantic Steamship Lines (predecessor to Sea-Land Service, Inc.) The ships had an average speed of 13 knots, a length of 469', beam of 72', a draft of 25', a dead weight between 7,865 long tons and 8,384 long tons, and could carry 226 35' x 8' x 8-1/2' containers. These six ships represented the total true container ship fleet in existence in the 1950's, although Seatrain had the capacity to carry containers since they could carry oversized vehicles. Each ship carried two gantry cranes, one forward and one aft of the superstructure, to lift containers from above or below deck, move them horizontally across the ship and land them on the dock.

The container fleet remained at 48,256 long tons until 1960 when Sea-Land converted two C2-S-AJ1 ships, originally built in 1944, to self-sustaining container ships. Each of these ships had a speed of 15 knots, a length of 504'; beam of 74', draft of 25', a dead weight of 8,514 long tons and could carry 275 containers. 1960 also saw the construction of 2 new ships with container capability: the FLORIDIAN and the NEW YORKER. The

NEW YORKER could carry 54 35' containers and 50 automobiles and the FLORIDIAN could carry 156 17' containers and 50 automobiles. Both were of the same design type, with a length of 360', beam of 52', draft of 16', dead weight of 2,191 feet and a speed of 16 knots. These were the first U.S. Flag ships designed and built from keel up to carry containers.

Matson Navigation Company moved into the field of containerization in 1960 with the conversion of two C4-S-A4s and one C3-S-A2 to non-selfsustaining container-ships. with a combined capacity of 1,268 24' containers. Matson Lines was operating on a closed loop between Hawaii and the West Coast, and found it more economical to mount the two gantry cranes at the ports rather than on ship.

In 1961 two partial containerships were added with a combined capacity of 384 30'x 8' x 8' containers.

In 1963 Grace Lines constructed three combination reefer ships that could carry 175 containers each. The number of container-ships built in 1964 and 1965 was small, but 1966 saw a spurt in the construction of new containerships. During that year 63,000 long tons of containerships (all partial) were completed. In 1967 an additional 81,000 long tons of new partial container-ships were completed and in 1968 five full and five partial containerships were completed, a total of 188,000 long tons.

By 1968 the United States Maritime industry had largely committed itself to containerization and unitization. For example, of 18 dry cargo ships completed in 1968, as noted above, five were full and five were partial containerships.^{1/} These 18 ships represented a total dead weight of 301,000 tons, of which 186,189 tons was full and partial containership construction (102,036 full and 84,153 partial). All containerships had speeds in the 20 to 22 knot range.

The trend toward larger ships also became apparent in 1968. The average dead weight tonnage for all ships (container and breakbulk) completed in the 1960-67 time frame was 12,600 long tons, in 1968 for all ships it was 16,200 long tons, with the breakbulk dry cargo ships averaging 13,100 long tons, partial containerships 16,830 long tons, and full containerships 20,407 long tons. Thus, the average full containership had a dead weight tonnage more than 55 percent greater than the conventional U.S. Flag breakbulk ship constructed in 1968.

At the end of 1959, containerships represented an insignificant portion of the U.S. Flag fleet. By the end of 1968 the 79 full and 103 partial containerships represented 43 percent of the total U.S. Flag fleet engaged in foreign trade. In terms of total dead weight tonnage, containerships represented 40 percent of the 5,180,000 long tons of U.S. Flag ships.

^{1/} Four ships were delivered during 1968, and two delivered in 1969 to U.S. Lines as full non-self-sustaining containerships. They were originally designed as partial containerships, but were modified while under construction.

Figure 4-1 shows the tonnage of full and partial containerships built or converted during the 1960s, which accounts for about 75 percent of U.S. containership tonnage. Not shown in the figure are 416,000 long tons converted to full or partial containerships for which information on the date of conversion was not available from the Maritime Administration. It should also be noted that 48,250 long tons were converted prior to 1960.

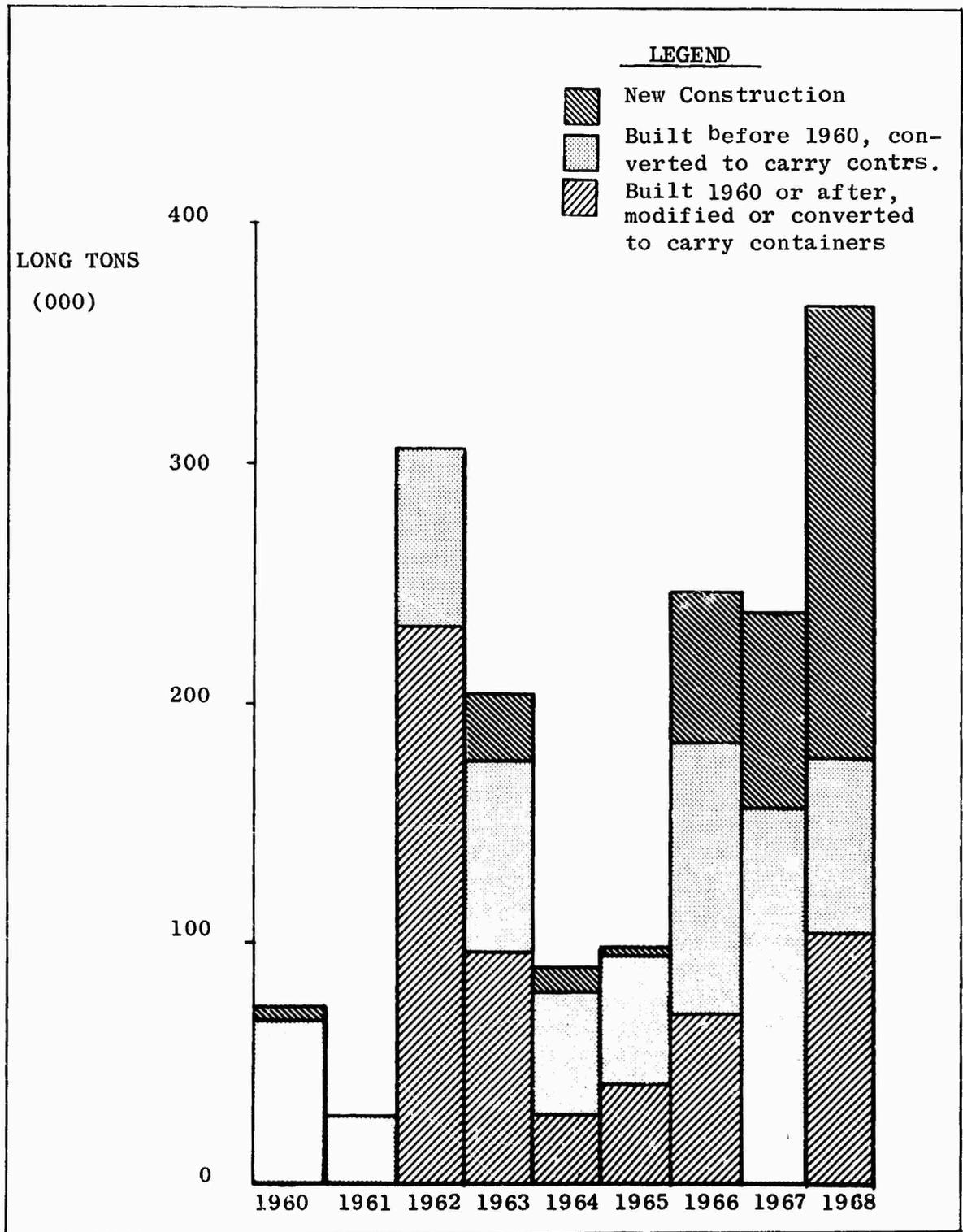
It is interesting to note that a major source of containerships in the U.S. Flag fleet has been the conversion of existing ships. Of the 79 full containerships in the fleet, 57 were constructed during World War II and extensively renovated during conversion. Of the 14 ships converted to full containerships in 1963, 8 were built after 1960.

Containerships on the CONUS-RVN Trade Route

The four C-2 ships used by Sea-Land for the CONUS RVN military trade route are converted C2-S-E1 ships described earlier, and are the oldest vessels in the Sea-Land containership fleet. Each ship is self-sustaining and can carry 60 reefer and 166 dry 35 foot containers.

The four Sea-Land full containerships of the Elizabethport class were converted in 1962 and 1963 from T-3 tankers built in 1941 and 1942. The T-3 jumbo conversion type ship has a speed of approximately 16 knots and can carry 476 35 foot containers in a self-sustaining mode. With the gantry cranes removed from the ship, the T-3 containership has a non-self-sustaining capacity of 525 containers.

The C4J class containerships used by Sea-Land were originally of the C4-S-A3 design type and were built in 1945. They underwent jumbo conversion in 1966 to non-self-sustaining full containerships. The ships have a speed of 17 knots, and can carry 663 containers (including 120 reefer containers).



Source: MARAD Report 30 June 1969

Figure 4-1. Containership Conversion and Construction

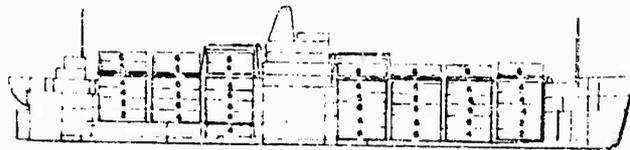
The capacity of 663 containers converts to 34,556 measurement tons maximum capacity. Based on an average 80 percent fill in the containers, these ships could be expected to carry an average of 27,728 measurement tons. MTMTS documentation has indicated that Sea-Land ships have manifested for as high as 26,000 measurement tons. The jumbo conversion type Sea-Land container-ships can thus carry an average load of over 7,000 measurement tons more than the maximum load of Mariner class breakbulk vessels which are approximately the same size as the C4J class before conversion. This increased capacity is made possible by the addition of an approximately 120 foot middle section to the ship during conversion and by stacking of containers above deck. Figure 4-2 shows the container configuration on the Sea-Land ships used in CONUS-to-RVN service.

Containership Design and Military Requirements

The design of containerships in terms of their selfsustaining or non-selfsustaining capability is of major importance to military planning. All of the five full containerships built in 1968 were non-selfsustaining, and indications are that this trend will continue. Of the 68 full containerships in existence on December 31, 1968, 34 did not have cargo gear or gantry cranes aboard. Of the 39 full containerships completed or converted after 1965, 26 were non-selfsustaining.

From the commercial operators standpoint, there are three major reasons for a preference for non-selfsustaining ships. First, shipboard gantry cranes have a slower discharge rate than land based gantry cranes. For example, a C2 self-sustaining ship carrying 226 containers was discharged and loaded at Manila in

RAPHAEL SEMMES (Converted C2)



SAN FRANCISCO (Converted T-3)



OAKLAND (Converted C4)

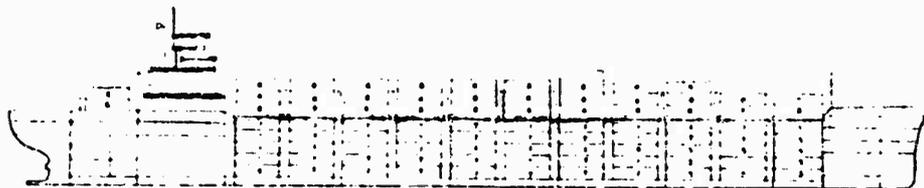


Figure 4-2. Container Configuration, Sea-Land Ships, CONUS to RVN

18 hours. A C4J non-self-sustaining ship with 663 containers can be handled at Cam Ranh Bay, using two land-based gantry cranes in the same period of time. Ship-board cranes are also more subject to storm damage and salt water corrosion than land-based cranes.

The second reason lies in the area of cost. While land based cranes cost approximately twice as much as ship based cranes, and are required at both the loading and off-loading ports, they are less costly as the number of ships serviced increases.

The third reason is that, at the present state-of-the-art, ship based gantry cranes restrict the container carrying capacity of the ship. Ship based gantry cranes run on parallel rails that extend the length of the ship, straddling the width of the deck. Current construction permits only double stacking of containers on deck, primarily because it is not easy to install side supports to maintain the stability of the containers and still maintain a clear running space for the cranes on each side of the ship. Installation of a gantry crane capable of clearing containers stacked four high, would result in unacceptable weight and cost penalties to commercial operators. Limitations in loading and unloading containers by ship-board crane stowed in the extreme fore and aft of the ship, also reduce the number of containers that can be carried in these areas as compared to a non-self-sustaining ship.

Thus, if a C4J non-selfsustaining vessel were made selfsustaining, its container capacity would be reduced by 169 containers. Even if it were possible to install a shipboard gantry that could clear three, rather than two tiers above deck, container capacity would be reduced by 97 containers. Figure 4-3 shows the areas of the C4J ship affected by installation of a shipbased crane and the resulting reduction in container carrying capacity.

Therefore, commercial containership operations will undoubtedly move more and more toward shorebased loading and unloading facilities. Ship profits are made by carrying containers, not gantry cranes. Maximum application of space in a space limited facility (such as a ship) to its cargo carrying mission is essential for profit maximization.

Such ships, however, do not meet all military requirements. Cargo movements to established ports under peacetime conditions or in secure areas in wartime can be handled most efficiently by non-self-sustaining ships. However, under contingency and rapid deployment situations requiring movement of cargo to undeveloped ports or involving over the shore operations, selfsustaining ships would be better suited for the mission.

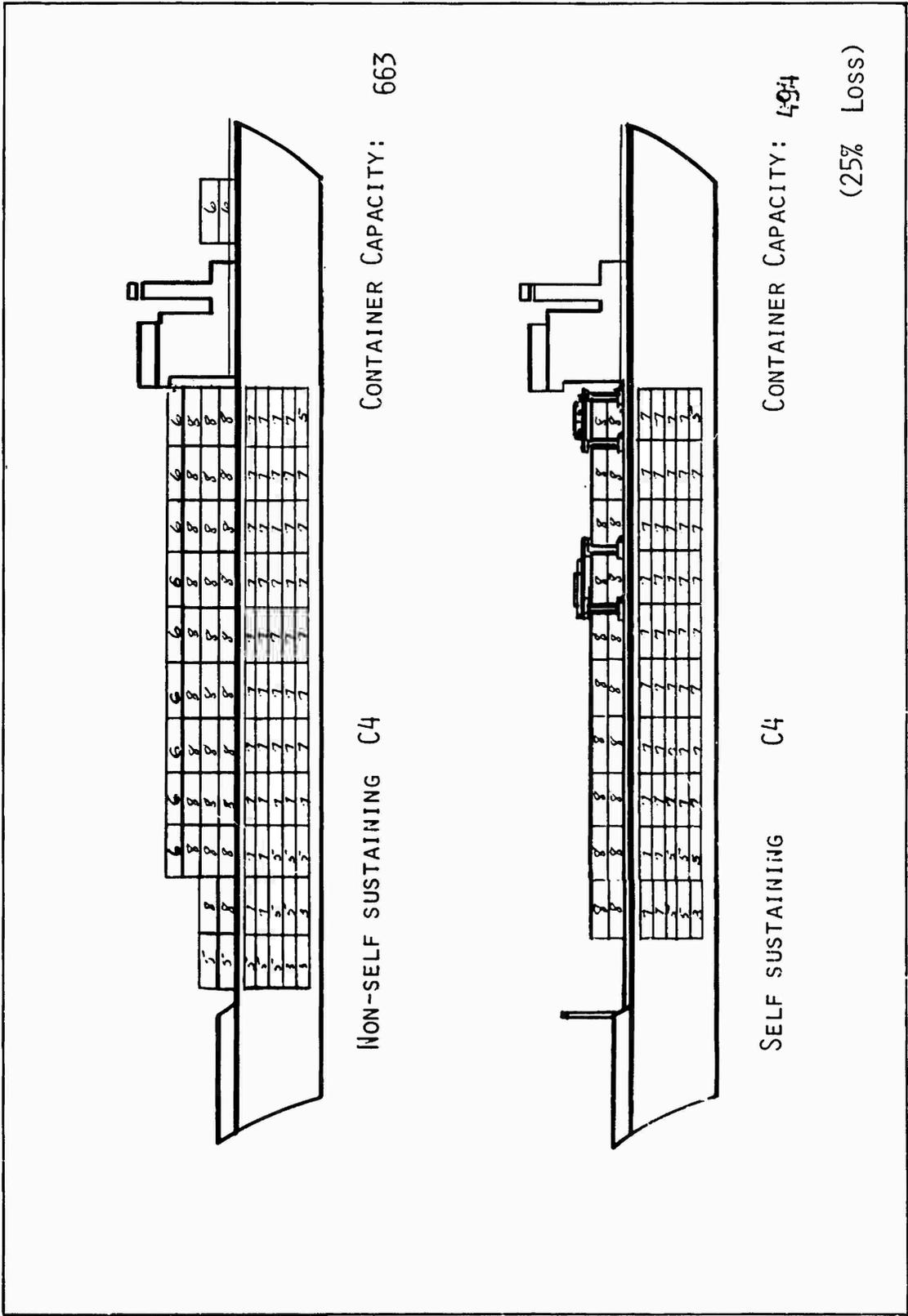


Figure 4-3. Non-Selfsustaining Ships Versus Selfsustaining Ships

Additionally, even in a developed port, security conditions may preclude installation of shorebased gantry cranes, which was one of the reasons for the decision to use selfsustaining ships to service Da Nang.

Currently, the operation of non-selfsustaining containerships is limited to developed countries on major trade routes. The trouble spots in the world, which are most apt to result in contingency situations are, for the most part, located in undeveloped areas. The problem of meeting the requirement for defense features on containerships, primarily a self-loading and unloading capability, will become greater as commercial containership operations become increasingly dependent on a shorebased loading and unloading capability.

Another problem area in military container operations is the lack of interchangeability among containers used by some of the largest shipping lines. For example, Sealand's 8' x 8-1/2' x 35' containers cannot be handled on U.S. Line ships, and U.S. Line containers cannot be handled on Sealand ships because of the cellular loading structure described above, which concentrate the weight of the container stack on the loadbearing corner fittings. Thus, a cellular structure designed for a 35 foot container cannot accommodate other sizes, either because of the cell size limitations for larger containers, its inability to prevent shifting and moving of smaller containers and the inability to concentrate weight on the load bearing corner fittings for stacks of varied size containers.

Matson Lines currently has under construction a new type of containership which offers one solution to this problem. The structural design of these ships eliminates the requirement for use of the cell guides to provide structural strength to the ship. Thus, cell guides can be relatively light and transferable, thus permitting the ship to accept container lengths in any combination of 120 feet per hold, i.e., six twenties, five twenty-fours, four thirties, etc.

Under such a concept, the conversion to accommodate a different size container would require modification of all cell structures within the affected hold at an estimated cost per hold of \$47,000 and the loss of use of the ship for one week.

However, most ships that have been built can handle only one container size. Thus, at the present time, there is little capability to provide a pooled fleet or interchange capability. It should be noted, however, that most U.S. Flag carriers are operating with 20 foot and 40 foot standard containers. Thus, while Sea-Land and Matson remain the world's largest containership operators, most companies that have entered the container market since the 1960s have standardized on the 20 foot and/or 40 foot unit.

Roll-On/Roll-Off Ships

Roll-on/roll-off (RO/RO) vessels are similar to containerships in that they carry containerized cargo in the broad sense of the term. The "containers", in this instance are wheeled and tracked vehicles, including trailers and intermodal containers on chassis. The method of loading differs from other ships in that the vehicles are driven or towed aboard the ship over ramps.

RO/RO ships operate, in many respects, in the same fashion as ferry boats. The vehicles, tanks, tractors, trailers and other vehicles are driven aboard and moved to their destination with little or no processing to the vehicles. For this type of movement it is no longer customary to drain fuel tanks or to apply protective coating to chrome plating for the voyage. RO/RO ships can also, of course, serve as a general cargo carrier when the general cargo is stored in a container, trailer, or truck bed.

This vessel type requires more cube for stowing a given amount of cargo than a true containership. About one-third of the ships useful cube is lost to the space under the vehicles occupied by the wheels. Additional area is lost because of the requirement for spacing between vehicles to permit access and maneuvering room. Ramps and elevators within the vessel for loading lower decks, and the clearance between the top of the cargo and deck beams also result in loss of space. It is estimated that roll-on/roll-off vessels require about twice the cube of a containership to carry an equivalent amount of cargo.

At present there are a total of 14 roll-on/roll-off ships and car carriers. The USNS Sealift and USNS Comet are owned by the

Department of Defense and the GTS ADMIRAL WILLIAM CALLAGHAN (owned by Sun Export Holding Corporation) is leased to MSTs. The remaining ships are privately owned and operated.

A relatively large percentage of military cargo consists of wheeled and tracked vehicles, and RO/RO ships provide a movement capability tailored to the characteristics of the cargo in the same sense that tankers meet the particular characteristics of liquid cargo. The cube factors discussed above and the design of the ship, limit their usefulness as movers of intermodal containers except on short runs with the container mounted on the chassis. The very short port time required for loading and offloading these ships results in major economies in short runs between several ports of call located short distances apart.

RO/RO Ships in RVN Service

The USNS COMET, the first military RO/RO ship, was delivered in January 1958. She is 499 feet long, 78 feet in beam, has a speed of 18 knots and a bale cube of 20,000 measurement tons. Only one additional MSTs nucleus RO/RO ship, the USNS SEALIFT, has been constructed. The SEALIFT was delivered to MSTs in 1967, is 540 feet long, 83 feet in beam and has a speed of 20 knots and a bale cube of 24,000 measurement tons.

In January 1959 MSTs acquired the USNS TAURUS a converted LSD built in 1944, from the Maritime Administration. The ship, formerly operated as the SS CARIB QUEEN, afforded additional, although marginal, RO/RO capability. The TAURUS was subsequently returned to the Maritime Administration for disposition in the Far East area, as it was determined the ship had reached the end of its productive life.

The newest RO/RO ship in the MSTs fleet is the GTS ADMIRAL WILLIAM M. CALLAGHAN, built by the Sun Shipbuilding and Drydock Company under contract with American Export Isbrantsen Lines and MSTs. The CALLAGHAN is 694 feet long, 92 feet beam with a speed of 25 knots and a bale cube of 34,000 measurement tons and is gas turbine powered. In March 1968, the CALLAGHAN crossed the North Atlantic in five and one half days at a record speed for cargo ships of 25.6 knots.

The CALLAGHAN has not been used in support of Southeast Asia because of the irregular flow and phasing of cargo, multiple ports of origin and destination, non-availability of suitable fuel. The high warfare risk value and the lack of ports in Southeast Asia which can accommodate a ship of her length are also limiting factors. The CALLAGHAN could conduct normal RO/RO operations at only the Da Nang and Cam Ranh Bay ports.

In April of 1965, the USNS COMET was redeployed from the Atlantic service to transport 12,000 measurement tons of cargo consisting of 75 LARCs and 260 vehicles to Vietnam. Following delivery of the cargo, the ship remained in the Far East service, engaged primarily in intra-RVN unit vehicle lifts from Saigon to Cam Ranh Bay, Qui Nhon and Da Nang. In the spring of 1966, the USNS TAURUS and SS TRANSGLOBE, a commercial RO/RO ship under MSTTS charter were transferred to the Pacific Theater to implement RO/RO service between Okinawa and Vietnam. This RO/RO operation provided scheduled service between Okinawa and Saigon, Cam Ranh Bay and Qui Nhon. It transported material and vehicles to Vietnam and retrograde cargo (principally major equipment requiring overhaul) on its return voyage. Regular shuttle service to Da Nang began in November 1967 and to Sattahip in January 1968. The USNS SEALIFT, after delivery to MSTTS in July 1967, was used in intra-Far East and Trans-Pacific operations on an as required basis as dictated by overall RVN support requirements. As noted above, the TAURUS was subsequently released for disposition in the Theater.

These RO/RO ships provided a valuable transportation service during the RVN buildup at a time when there were insufficient port facilities. The inherent rapid loading and discharging rate of these ships permitted rapid port turnaround, a most important asset in periods when port congestion was a major problem, as well as a means of moving a type of cargo poorly suited to the breakbulk shipping mode.

Seatrains

The Seatrain vessels were the earliest efficient carriers of containerized cargo. Though they were not truly containerships as we now know them, they preceded the containership by twenty-five years and provided a basis of valuable experience for later development of the containership.

Seatrains are most effectively used in carrying heavy and outsized wheeled and tracked vehicles, rolling stock and wheeled and tracked military and construction equipment. The Seatrain can also serve as a container carrier.

At present there are 15 Seatrains in the U.S. Flag ship fleet. The oldest are the NEW YORK and SAVANNA, both built in 1932. Both ships have a dead weight of 11,531 long tons, and a speed of 16 knots. The Seatrains NEW JERSEY and TEXAS were built in 1940, each with a deadweight of 11,576 long tons, and a speed of 15 knots. The Seatrains GEORGIA and LOUISIANA were built in 1951, with a deadweight of 10,039 long tons, and a speed of 16 knots. An additional nine Seatrains (CAROLINA, DELAWARE, FLORIDA, MAINE, MARYLAND, OHIO, PUERTO RICO, SAN JUAN AND WASHINGTON) are conversions of ships originally built as T-2 tankers in 1944. These conversions have a deadweight of about 12,000 long tons and a speed of 16-1/2 knots.

In the original design loading was performed by a special fixed shore gantry crane with outriggers extending over ships on both sides of the dock. The freight car to be

loaded was positioned on and secured to a loading cradle, lifted and lowered into a selected cell in the well of the ship and landed on a selected deck. The freight car was then pulled either fore or aft on rails to its position and secured to the deck.

Seatrains can carry wheeled or unwheeled containers which, before loading, are placed on low profile, wheeled dollies designed for operation on railroad tracks. The container and dolly are then loaded in the same manner as a freight car.

There is a great amount of wasted cube in the midship section of the original design ships and recently (late 1950s and early 1960s) some of these early vessel types have been modified to accommodate containers below deck more efficiently. The tween deck has been removed, containers are loaded without a cradle and stacked 3 high upon powered dollies which run over fore and aft tracks on the tank top. On reaching its stowed position, the dolly with its 3 high stack is secured for the voyage. The top container in each 3 high stack is restrained from horizontal movement by guides projecting down from the underside of the main deck. Those in lower tiers are restrained by the weight of the containers above them.

The Seatrains GEORGIA and LOUISIANA were converted by the Sun Shipbuilding Corporation for Seatrain Lines Inc., and can carry hold containers, railroad cars or both. Containers are held in place by rail clamps both above and below deck. The ship has no cargo gear and must be serviced by a shore based gantry crane.

The PUERTO RICO class Seatrain has bulk capacity of 17,000 measurement tons. Figure 4-4 is a profile sketch of a PUERTO RICO class Seatrain used in the CONUS-Vietnam trade route. The ship has two fifty ton series electric cranes and a single large hatch for loading outsized equipment.

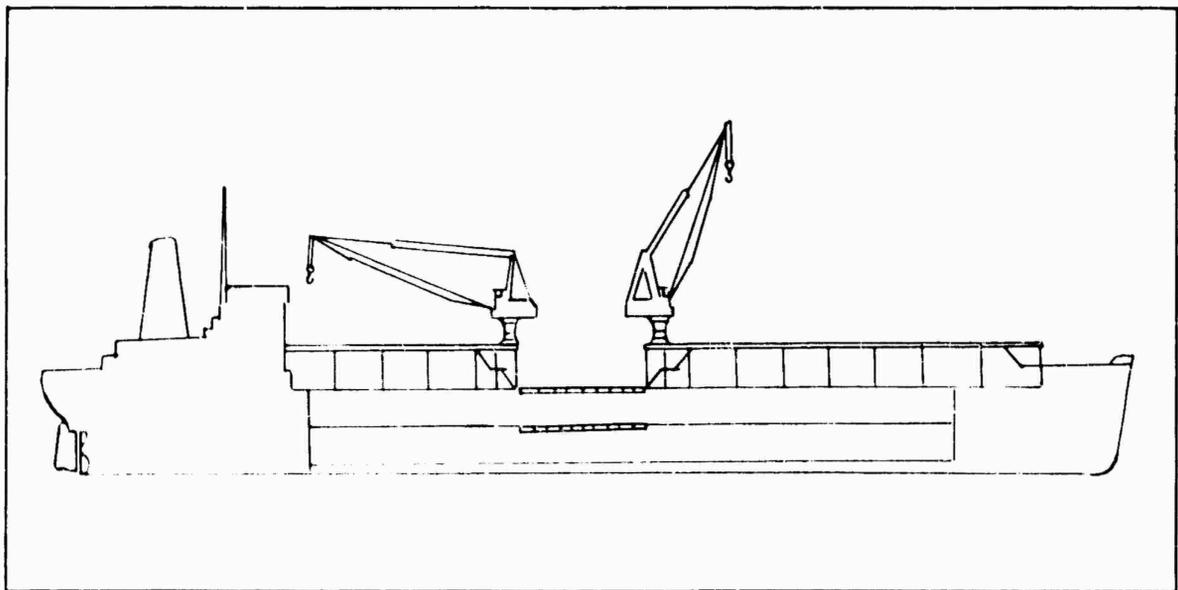


Figure 4-4 PUERTO RICO Class Seatrain

MSTS chartered 12 Seatrails during 1966 to provide additional lift capability required as the result of the Vietnam operation.

While Seatrails are generally less efficient than the other vessel types for the transportation of military cargo, low-profile vehicles and non-rollable special cargo, they provide an excellent means of moving outside cargo, including aircraft. While not as efficient as an aircraft carrier, they provide a reserve capability when carriers are not available.^{1/}

They have been used for unit moves of battalion and larger complements with considerable success. MTMTS reports that, with the assistance of the Transportation Engineering Agency, an engineer battalion, was moved on a single Seatrain to Vietnam, where earlier planning had anticipated a requirement for two vessels. This was accomplished by loading unit impedimenta on unit vehicles to take full advantage of the shipping cube. In the case of the battalion mentioned above, the Seatrain sailed with 16,080 measurement tons out of a bale capacity of 17,000 MTs. One result of this move was a recommendation that all Battalion and larger units be moved on Seatrails until better ships are available. Combat loading on these vessels, and with this method of packing, turned out to be the cheapest rather than the most expensive way to move combat vehicles, as formerly believed. ^{1/}

^{1/} MSTs Briefing to JLRB, 10 June 1969

LOTS OPERATIONS

Until 1966, the only deep draft pier facilities adequate for handling oceangoing vessels in the Republic of Vietnam were located at Saigon. Of the ten berths available in Saigon, six were made available for military use. This shortage of berthing space coupled with the inadequacy and lack of security of most land lines of communication, resulted in much of the intra-theater distribution functions being accomplished by transshipment along the Vietnam coastline. Shallow draft vessels were used for this purpose, delivering cargo to several underdeveloped small ports in Vietnam. Originally the transshipment function was accomplished by 17 USNS LSTs. An additional 8 LSTs, manned by Japanese and Republic of Korea crews, were added in May 1965, and in May of 1967 an additional 42 USNS and 5 USS LSTs, manned by Navy crews were added to the inventory in Vietnam, for a total of 72 of these vessels in service in Vietnam.

In addition to a transshipping capability, a requirement also existed for a lighterage capability to support over the shore movements. In February 1965, 12 LCUs and 52 LCMs were positioned in Vietnam, and in early 1966, they were augmented by two LARC V companies to conduct lighterage operations. Additionally, barges and BARCs were used for lighterage.

A major problem in LOTS operations was the poor condition of much of the available equipment. Although Department of Army had a large inventory of amphibious equipment, much of it was built in the early 1950s for use in the Korean War and was in poor repair. Consequently, at the beginning of the Vietnam buildup in 1965, vessels in storage required drydocking and

overhaul before issue. Maintenance problems were numerous, primarily because of the large amount of non-standard accessory items used in the equipment, which produced severe problems in repair parts support. Maintenance capability in Vietnam was limited with most overhaul performed at Okinawa, the Philippines and Singapore and down time for out of theater maintenance averaging 6 to 9 months.

In spite of these problems, large scale LOTS operations, were accomplished in Vietnam, particularly in the Da Nang area, one of the four major ports in Vietnam. Navy units were assigned responsibility for the port operation and support of troops in the I Corps Tactical Zone. Supplies were brought into Da Nang in oceangoing vessels, and unloaded with most of the cargo then transshipped along the 225 mile I Corps coastline to shallow draft ports and inland river landings.

Transshipment of cargo from Da Nang to the various detachments along the coastline and riverlines was accomplished by three principal means: barges, LSTs, and shallow draft LCUs and YFUs. The "U" boats were found to be the most versatile because of their short cycling times, readily adaptable cargo space, relatively good characteristics in poor weather and their ability to move through narrow twisting river channels to inland offloading points. In addition to the LCUs initially available, the Navy purchased 11 Skilak (YFU) boats, an application by the Navy of a previously existing commercial design. These boats, with a capability of moving 260 short tons of dry cargo or up to 88,000 gallons of diesel fuel in cargo tanks at 8 knots were found to be highly satisfactory.

The U.S. Army beach discharge lighter, LT. COL. JOHN U.D. PAGE also proved to be a valuable item of equipment for LOTS operations. The PAGE was designed to transport large quantities of mobile and/or outsized equipment from ships standing offshore to undeveloped beaches during LOTS and over the beach operations. Additionally, the PAGE had the capability of offloading a RO/RO ship in the stream via gangways from the mother ship to the PAGE, and thus becomes a RO/RO lighter. The PAGE has a speed of 11-1/4 knots and an ocean cruising radius of approximately 4,800 miles.

A review of LOTS operations in Vietnam during the 1965-1968 period results in three major conclusions:

1. While LOTS operations were extremely important in the early stages of the operation prior to completion of deep-water ports, the completion and operation of the ports did not significantly decrease the requirement for LOTS operations. As the level of combat increased and spread to various parts of South Vietnam, requirements for movement of supplies from the major deep-draft to the expanded areas of use increased. Highway and rail limitations at this period resulted in a considerable amount of these shipments being made by intra-coastal shipping to under- and undeveloped ports and landing areas.
2. Containers were not used in LOTS operations during the period studied. The lack of equipment suitable for handling containers in this type of operation, and the terms of the container contract used in support of Vietnam operations (particularly the short turnaround time allowed in country) precluded this type of operation.

3. The equipment available for this type of movement was not designed to handle nor capable of effective handling of intermodal containers. The LCUs and LCMS were built, for the most part, on World War II concepts for handling combat vehicles and assault landings and were not conceived for efficient operation in modern logistic support.^{1/} Although most of the vessels could physically accommodate containers on chassis and discharge in the RO/RO mode, this represents a relatively inefficient means of moving containers. Space requirements for the chassis and the inability to stack containers mounted on chassis generally limits the number of containers that can be moved on small vessels. The most successful ship for this type of operation was the PAGE, but even this ship was limited by the number of decks usable for this purpose and the requirements to move containers in a RO/RO mode.

In summary, it can be stated that LOTS operations has provided an important element of the logistic support function in Vietnam. Had available LOTS equipment permitted a large scale use of intermodal containers in LOTS operations it would have provided an improved means of redistributing cargo along the coast of Vietnam, particularly in those cases where cargo could be moved in the container without unloading or reloading at the point of entry into Vietnam. The equipment available for such movements, however, would have restricted container operations to essentially a small-scale

^{1/} Fact Sheet Attachment, Letter, Brig. Gen. Arthur Hurow to Maj. Gen. Heiser, 3 January 1969.

RO/RO type of operation with the container on its chassis for the entire move. This problem has been recognized and a request has been made for a test to determine improved means for using intermodal containers in LOTS operations.

Land Transport

Land movement of intermodal containers is accomplished by rail and highway. These modes, within the United States, form the link between the shipper and the ocean carrier for overseas shipments. The importance of these forms of transportation is apparent when considering the concept of the United States as a highway and rail land bridge between the Far East and Europe. It is estimated overland transport, in addition to reducing reliance on the Panama and Suez Canals, would reduce time required for an all water movement by a minimum of two weeks, an advantage which must be weighed against the countervailing costs involved. This area is subject to active proposals which render an evaluation of the "land bridge" premature at this time.

The truly intermodal characteristics of containers are also best appreciated when looking at overland movements which may start by highway, continue by rail, revert to highway and end in a ship for movement to a foreign port where rail and highway modes will continue the move.

Rail

"Piggyback" movement of trailers and/or containers on railroad flat cars was initiated by American railroads in 1955. Under this concept, trailers, containers mounted on chassis, or dismounted containers are carried by rail, generally for long haul moves.

The major advantages of this system over other methods of rail transportation are that it permits faster service through faster terminal operations; provides service to areas which do not have rail service; and provides better protection of cargo on route. Essentially, it provides a combination rail and trucking service using the more economical elements of each mode of transportation.

Since 1955, piggyback volume has increased rapidly. In 1955, 158,000 carloads of such cargo were reported. By 1966, this had increased to 1,163,000 carloads, with a consistent 13% annual rate of increase over the period. Tonnage moved has increased from 5.4 million tons in 1955 to 33.4 million tons in 1965, while the percent of potential piggyback cargo moved by this means has increased from 2.1 percent in 1955 to 12.2 percent in 1965.

The piggyback fleet owned by railroads, however, currently consists primarily of trailers (87 percent) with only 13 percent of the fleet represented by containers, and the railroad owned fleets have consistently accounted for 70 percent to 80 percent of all piggyback movements. Although there are many advantages to container-on-flat car operations (reduced tare weight, lower point of gravity), there are also major disadvantages, primarily the reduced flexibility resulting from the use of demounted containers, the capital outlay required for container handling equipment and interchange problems between container trains and trailer trains. Additionally, available rolling stock does not normally permit carrying more demounted than mounted containers.

Rail service has been used during the Vietnam operations for the movement of Sea-Land containers to the west coast depot and port complex. Rail service was used to provide for the movement of Seavan containers to Ogden and Tooele as well as other contractor activities in the Salt Lake City area on a round-trip basis to tie in with the empty movement from the port. Piggyback movements were used to move Sea-Land containers from Red River to Oakland and return. Rail movement was not used within Vietnam for containers because of the limitations on the use of rail equipment in the country.

Rail piggyback operations afford a means of transporting containers within CONUS. The movement of containers on a chassis, however, while providing flexibility, results in a requirement for more chassis than would be required for movement of the container alone. A current effort to design a rail car specifically for movement of containers without chassis will allow more effective utilization of available space by permitting the loading of more containers per rail car.

These restrictions, as noted above, are related primarily to the lack of suitable interface equipment for handling containers at destinations, and the capital investment required to provide such interface equipment.

Highway

The second method of transporting containers over land is by highway. The basic highway vehicle for containers is a simple truck or

semi-trailer chassis equipped with special tie-down facilities and guides for receiving the containers. Straight trucks can normally carry one 20 foot container; semi-trailer units can carry one 40 foot or two 20 foot containers. Adaptor frames are available for mounting on a conventional flatbed trailer.

Many limitations on this form of transportation are regulatory. 1/ Current container weight and size limitations are based primarily upon highway weight and size limitations placed by various state regulating agencies. The hauling of two or three container vans in tandem by one tractor would be more economic and effective than hauling one per tractor. However, highway regulations generally prohibit this type of move. The lack of standardization in container sizes also discourages the hauling of containers on chassis other than those fitted for a particular size.

Highway movements of containers in CONUS were used extensively for support of the Vietnam operations, particularly in the respective depot and port complexes. For military operations, particularly in periods of high level of activity and port congestion, it is essential that sufficient chassis be available to match the containers arriving at the port. Vietnam experience at west coast ports showed that container operators other than Sea-Land frequently did not have sufficient chassis to match incoming containers. This situation slowed movement of these containers through the port, and their movement by other than chassis designed for container movements was more costly.

1/ See APJ Reports 504-1 and 504-2, "U.S. Army Cargo Containerization Requirements" for a more detailed discussion of this subject.

Major problems encountered in operation of overland transport containers in Vietnam resulted from poor roads, and the steep grades found in some of the mountain passes which had to be negotiated (e.g., Qui Nhon to Pleiku). The M52 military tractors, generally used for hauling containers beyond a thirty mile limit from the port, were found to be inadequate when hauling a full container load through these mountain passes, resulting in overloading of the tractor power plant and premature failure of brake linings. It should be noted that these problems were not unique to the movement of containers and were also encountered in linehaul of heavily loaded stake and platform equipment.

However, most inland container movements in Vietnam were made in close proximity to the port of debarkation with the contractor providing highway movement within a thirty mile radius of the port. The road conditions mentioned above, problems of road security, and the relatively short turnaround allowed in Vietnam limited long haul movement of containers by highway.

Airlift

Although it is physically possible to carry the 20' intermodal container on some aircraft types currently used, the weight and volume restrictions on today's aircraft make tare weight criteria extremely demanding. Today's aircraft configuration also frequently imposes shape limitations on cargo containers. Thus, as noted earlier in the report, much air cargo at present is unitized through palletization or placed in small containers (igloos, hula huts) of a variety of shapes and sizes ranging from 6 cubic feet to 465 cubic feet. Many of these are special purpose containers, particularly designed to match the size and shape of

the aircraft section in which they are stored. Until the Boeing 747 and the C5A Aircraft are in operation, this situation can be expected to continue.

Therefore, while the airlift of intermodal containers could have played a large part in relieving the congestion at aerial terminals, both in CONUS and Vietnam, the limitations noted above for the most part, precluded its use during the Vietnam operation.

INTERFACE EQUIPMENT

The intermodal characteristics of containers result in a relatively high number of interfaces during their cycle from loading at point of origin to unloading at destination, reloading, return and unloading. In a typical military movement, (see Figure 4-5) loading of the container will take place normally at a depot or vendor site, the container will be moved by rail or highway transport to the port of embarkation, loaded aboard ship, moved to the port of destination, removed from the ship and moved to a depot area or other selected point for unloading and return. The container may be reloaded before return or return empty. In either case, it will revert to a port in the United States for further use as a cargo carrier.

Interfaces occur whenever the contents of the container are affected, or when the container itself as an item of cargo, requires handling. Therefore, interface equipment can be divided into two major categories:

1. Equipment to load and unload cargo into and from the container (stuffing and unstuffing)
2. Equipment to lift and move the container itself.

Table 4-3 lists some of the major types of interface equipment required for these two

<u>INTERFACE POINT</u>	<u>TYPE OF OPERATION</u>	<u>EQUIPMENT TYPES</u>
Depot and Port Marshalling Yard	Container lift, stacking, move- ment and transfer	Front loading fork- lift truck Side loading fork- lift truck Straddle carrier Mobile hydraulic lifting legs Container casters Air Cushion pallets Wheeled portable crane Crawler portable crane Totetainer Tilt bed trailer
Depot Warehouse or Other Load- ing and Unload- ing Areas	Container stuff- ing/unstuffing (with warehouse dock)	Forklift truck Rough terrain fork- lift truck Pallet jacks Conveyors Transfer packer (for bulk dry car- go stuffing)
	Container stuff- ing/unstuffing (without ware- house dock)	Portable ramps and forklift truck Hydraulic lift and forklift truck Rough terrain fork- lift truck
Railroad Yard	Container lift and transfer	Railway overhead straddle crane Flexivan loader Wheeled portable crane Crawler portable crane Front loading fork- lift truck
Port Shiplside	Container lift and transfer	Pierside gantry crane Heavy lift floating crane Spreader frame with automatic self-level- ing and container hooking devices Wheeled portable crane Crawler portable crane

Table 4-3 Interface Equipment Requirements

functions at major interface points in a container movement.

Container Stuffing/Unstuffing Equipment

The most common type of interface equipment used for stuffing and unstuffing of containers are forklift trucks. Front loading forklift trucks move palletized or unitized cargo directly into the container and offload directly from the container. Rough terrain front loading forklift trucks are also used in the stuffing and unstuffing function. These trucks, as their name implies, can operate effectively in unimproved areas.

For cargo not palletized or unitized, roller conveyors for hand loading can be used and dry bulk cargo can be stuffed into a container by a transfer packer which mechanically moves the dry material into the container to the height dictated by the cargo density.

In instances where warehouse loading docks are not available, portable ramps are normally used. These ramps are set into position so that forklift trucks, pallet jacks or other equipment can ride up the ramp from ground level to the interior of the container. Hydraulic lifts may also be utilized to lift the forklift truck or pallet jack on a platform to container floor level, at which point, the materials handling equipment can move directly into the container.

Container Movement Lift and Transfer

The size and weight of the container and the requirement to maintain its equilibrium makes its movement more complex than for pallets or individual average sized boxes. The use of larger, more elaborate and costly equipment is therefore required.

Container interface movements include the lift on or off a transport vehicle, (the transfer between vehicles) and movements

and lifts within and between marshalling and warehouse areas. The latter type of movement is normally over short distances, with lift requirements related to stacking or to positioning on a chassis or other wheels for moving.

Movement of containers on, off and between transport vehicles (except for piggyback rail cars and RO/RO ships) is normally accomplished by some type of crane. The gantry crane is commonly used for shiploading and unloading, with the crane either installed on the pier or on the ship itself. Railway overhead straddle cranes, sideways transfer equipment, Flexivan loaders, wheeled portable cranes, crawler portable cranes, and heavy lift loading cranes are all used for this operation. Additionally, some heavy duty front and side loading forklift trucks have the capability of lifting and moving containers.

Various devices are used for the lift and movement of containers within the marshalling yard, and warehouse areas and between these areas. The straddle carrier has been developed specifically for such movements. This carrier can stack containers off chassis up to three high, and can be used for moving containers from the marshalling area to other points, including shipside when necessary. It is also used for railroad flat car and container chassis loading.

Air cushion pallets, although not widely used at present, are being introduced and their use will undoubtedly increase when container movement requirements are sufficient to warrant their cost. Mobile hydraulic lifting legs, which can be operated by one man, are also used to raise and lower the container from the ground as required. This lift permits the insertion of casters into the four lower corner fittings of the container for movement of the container short distances within the marshalling yard.

Yard tractors are used extensively for moving containers in depots and port areas when the container is loaded on the chassis.

Various other types of specialized equipment have been and are being developed for the movement of containers. The container has had a major impact on interface equipment and the success of container operations, to a great extent, depends on the capability of interface equipment to meet the requirements of the container for rapid movement at interface points.

There were numerous problems in cargo handling in Vietnam related to interface equipment, some of which undoubtedly delayed the use of containers until they were resolved. Much of the materials handling equipment in Vietnam in the early part of the conflict was in poor condition, and experienced low readiness rates and high maintenance requirements. Shortages of certain types of forklifts were also common during this period. The excessive wear and tear resulting from the Vietnam environment and long duty cycles, contributed to the high downtime rate and lack of availability of this type of equipment. Additionally, much of the equipment used in Vietnam were of designs not specifically suited for the workload experience there. For example, the front loading forklifts used for container stuffing and unstuffing of the 8'6" high Sea-Land container had a door clearance of only 3". The use of standard 8' high containers would have required modification of the forklift or supply of a type with a lower profile.

The requirement to install pierside gantry cranes at Cam Ranh Bay for handling of non-selfsustaining containerships required a major effort and delayed initiation of service to that port for some months until it was completed. Limited port facilities, road networks and hardstands, both at ports and depots also presented severe problems in interface equipment operations in the early cargo distribution buildup period and until these

problems were resolved, large-scale container handling would have been difficult. By the end of 1968, most difficulties had been overcome and a highly successful container operation was in being.

CONTAINERS

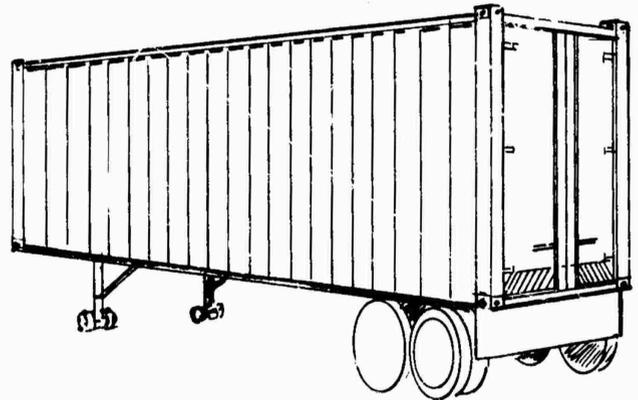
An intermodal container, for purposes of this discussion, is defined as a reusable receptacle, equal to or greater than 5' long, 4' or 8' high and 8' wide in its outside dimensions, designed to be moved by all modes of transportation and fitted with standard corner devices and other fittings required for handling and transfer from one transportation mode to another.

Six of the more common types of containers used in cargo distribution are shown in Figures 4-6 and 4-7.

1. Dry Cargo Van. This van makes up the largest part of today's container fleet. Cargo for this container is normally unitized or palletized to permit the use of forklift trucks in stuffing and unstuffing the container.
2. Dry Cargo-Open Top. This container type is similar to the dry cargo van, except that it has an open top, covered with a tarpaulin tied down to the side of the container walls, when loaded. This container is used primarily for transporting heavy machinery and large items of equipment which can be loaded and placed in the container more efficiently through the open top than through a door opening. It is also better suited for loading very long cargo items, such as long lengths of piping or timbers, which cannot be readily handled by forklift trucks. The container has standard hinged doors at the rear, and can be used as a dry cargo container when desired.

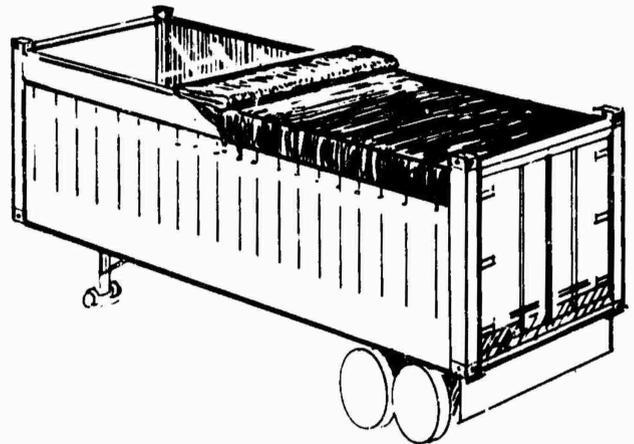
DRY CARGO VAN

Type used for most unitized, palletized and packaged cargo. On/off-loading through rear door.



DRY CARGO-OPEN TOP

Used for special cargo, e.g., pipes and machinery. On/off-loaded vertically from the top or through rear door.



CONTROLLED TEMPERATURE

For perishable cargo which must be maintained at low constant temperatures.

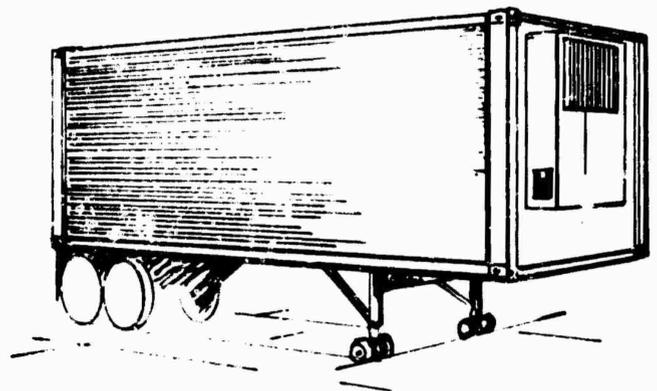
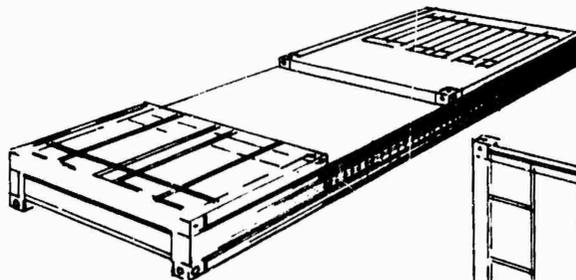
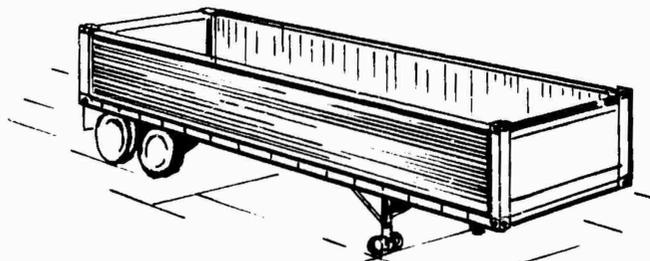


Figure 4-6. Container Types Used in Cargo Distribution

3. **Controlled Temperature.** This is an insulated van with an internal refrigeration unit mounted in the container. The principal use of this container type is for perishable items. It may be used for movement of any containerizable item requiring controlled temperature conditions in transit. Other common uses are for the transporting of some types of batteries, and certain types of medical supplies. Variations may include a van with a heating rather than refrigerating unit and, in some instances, an insulated van with no heating or refrigeration unit. The latter type would tend to slow the rate of temperature change of cargo from its temperature when loaded, and prevent the accumulation of excessive heat or cold from outside sources.
4. **Short Height-Open Top.** This container is a dry cargo, open top container, half the height of the standard containers described above. It is primarily used for transporting high density cargo where weight rather than cube is the limiting factor. The half-height reduces the cube by half, thus reducing the unused cube resulting from shipment of high density items in larger containers.
5. **Pallet Container.** The pallet container has a floor bed with front and back ends but no side walls or roof. When empty, this container can be collapsed by folding the forward and rear ends parallel to and flush with the floor, thereby reducing shipping space when the container is moved empty. The container can be loaded from the top and from the sides and is particularly well suited for use of forklift trucks in the stuffing process. However, the

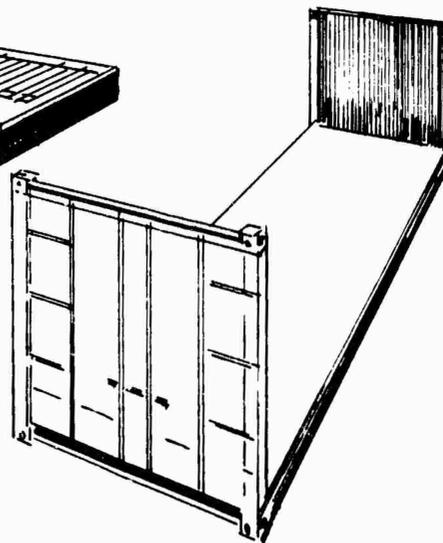
SHORT HEIGHT-OPEN TOP

Same as dry cargo open top with one-half height. For high density cargo which makes full height container weight limited.



PALLET CONTAINER

For cargo which can be tied to container floor. Advantage of collapsibility and side loading.



TANK CONTAINER

For bulk liquids. Many alternative configurations.

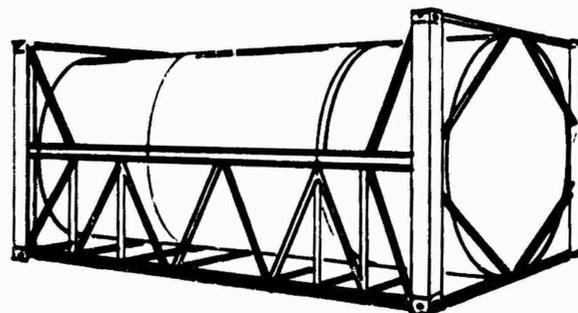


Figure 4-7. Container Types Used in Cargo Distribution

cargo in this type of van has to be particularly well secured to the container floor to prevent shifting during transportation.

6. Tank Container. The tank container is used for transportation of bulk liquids and has been produced in several configurations related to the density and chemical composition of the cargo to be transported. The container tank is filled through an intake orifice which is connected by external piping or hose to a larger capacity storage tank, or tanks, for movement. At the point of discharge, the container contents are pumped into permanent storage facilities.

As noted above, there have been many other types of containers used, including Army and Air Force Conexs, small containers of various shapes and sizes used in airlift operations. However, the truly intermodal containers have developed along the types described above.

A major problem which has faced the container industry has been that of standardization. A considerable amount of effort has been devoted to this objective by the various agencies, including the International Material Management Society, the American Society of Mechanical Engineers, the United States of America Standards Institute and the International Standards Organization. Standards are of considerable importance, of course, as they directly affect the construction maximum payload capacity, interchangeability and intermodality of containers.

The United States of American Standards Institute has adopted and published USASI MH5.1-1965 specifications for cargo

containers. In June 1967 the International Standards Organization adopted an international specification similar, in most respects to USASI specification.

USASI standard containers are 8' x 8' in cross sections and in nominal lengths of 10 feet, 20 feet, 30 feet, and 40 feet. The DOD military specification for cargo containers, Mil-C-52661, published in August 1969 was based on the ASI MH-5 specification. The ISO series standard provided for these same dimensions, but additionally provided for container lengths of 6-2/3 feet and 5 feet. A second series of containers smaller in all dimensions than the USASI standard was also included.^{1/} As can be seen, the USASI and ISO standard container lengths permit container coupling in multiples to permit single or coupled container loads ranging from 5 feet through 40 feet.

Standards for cargo containers used in current aircraft have been established by both the Air Transport Association (ATA) for domestic use and the International Air Transport Association (IATA). These containers are small (7 feet 4 inches long and less), and are not intermodal. The IATA lists 17 sizes of containers, including four types contoured to fit the fuselage. The ATA lists six sizes, four of which are contoured, only three of which match IATA standards.

In August 1968, SAE Specification AS832, for Air-Land demountable containers was published. This specification established 10, 20, 30, and 40 foot lengths and 8 foot width and height dimensions for Air-Land containers to match the USASI specification. The standard provides for a truly intermodal container for use with the large aircraft shortly to become operational.

^{1/} Container News, January 1970, states that the ISO recently changed the standard height for 40 foot containers to 8-1/2 feet.

In spite of the standardization efforts discussed above, two of the leading container transport companies in the United States (Sea-Land Service, Inc. and Matson) are using container sizes varying from these standards. The Sea-Land container is 8' wide x 8'6" high x 35' long; the Matson container is 8' wide x 8' 6-1/2" high and 24' long. These two companies thus move cargo in only their own containers, with their transfer and lifting equipment as well as containerhips designed to match this configuration.

The logic of container standardization is based on the intermodal nature of the container and its operating cycle. Any item which must flow freely across national and international boundaries and across three or more modes of transportation with the interfaces and transfers involved must be (a) standard, and (b) compatible with the movement and handling environments in which it must operate. Since the container moves through the transportation lifeline, it must be, in the true sense, a "common denominator". This key consideration has, of course, been recognized by the efforts of the respective standardization committees.

Since standards are the subject of voluntary adherence, they are subject to the self interest of the parties concerned. Where they do not fulfill an essential purpose, or where standardization results in higher investment costs or uneconomic operation, they are subject to question by any of the diversity of interests involved in a given trade route or industry area. Typical motivation arises from the physical nature of the cargo, the trade route, and the legalities involved.

An examination of actual container dimensions and experience can show where the dimensions are relevant and where they are

susceptible to deviation. At present, the dimension of 8' width is adhered to almost universally, with length standards frequently honored in the breach. Thus, there are concurrently in use or in procurement containers with dimensions of 20, 24, 27, 35 and 40 foot lengths. Heights vary from 7-1/2 to 8-1/2 feet.

The reasoning behind these variations is not hard to find. Eight feet is the present highway width dimension and is compatible with the bulk of U.S. highway vehicles. Therefore, a container may ride with equal comfort on a specially designed chassis, or tied down on the flatbed. If it is narrower, it wastes cube; if it is wider it becomes illegal. Were the law to change and wider dimensions become permissible, then it would be incompatible with the several millions of trailers and chassis presently in existence.

The same rigidity cannot be stated for height. Limiting heights in the United States are usually 13'6" for the tractor and trailer, i.e., the container on its chassis. There are no serious height limitations in the ocean, rail, or terminal stages of intermodal operation and an additional half foot added to the 8' standard height offers a very convenient way of gaining 6-1/4 percent in volume without alteration of the platform dimensions. This is paralleled by changes involving decreases of height (e.g., gondola containers which are frequently not more than four feet in height) intended for high density cargo, where unrequired volume is eliminated.

However, density considerations shows its greatest impact in the diversity of lengths cited above. The 20' container loaded with machinery may have a gross weight that

is more than a 40' container carrying dresses. The diversity and scale of cargo flowing in commerce is simply too great to permit a procrustean bed in the face of economic reality.

What then have been the forces standardizing lengths? It is a historical fact that containers have been traditionally owned by ocean shipping companies. Moreover these companies began with containerships which were essentially conversions of previous hulls. In this pioneering aspect, the typical mode of construction was to substitute for the transverse bulkheads and diaphragms of the original vessel, the strength and loadbearing capability of the container guide rails - thus using the guide rails for two purposes: (a) to restrain and control the movement of the container and (b) as an integral part of the loadbearing structure of the vessel. When these factors are taken together, it becomes clear that the ocean movement leg enjoyed a high priority - because of the cost pre-eminence, because of the institutional affiliation with the steamship company, and because the extraordinary economic advantage of the container over breakbulk movement was such that substantial inefficiencies could be accepted without loss of the overall economic gain.

Thus, movement of cargo between the west coast depot and a forward distribution point to Vietnam could be performed at an overall cost of 25 percent less per measurement ton using a 35 foot container than by breakbulk, despite the fact that containers were seldom loaded beyond 75 to 80 percent of capacity.

The situation is drastically changing, thanks to the response of the ship building industry to the requirement for new vessels.

Thus, new vessels being constructed by the Matson Company as noted above, are using a structural design relying on the structural strength of the vessel sides, bottoms, and transverse members, with the loadbearing requirements for the vessel divorced from those of the container.

Similar designs have been proposed. For example, the APJ "spine and rib ship" (reference APJ 128-4). This design utilized the principles of aeronautical engineering to produce a vessel whose structural integrity is completely independent of other than its primary structural members.

One result of this change is that cell guides are relatively light and readily transferrable, permitting great flexibility in handling containers of different lengths. The problem of standardization is then reduced to proper preplanning of respective modules to insure that the ship weight and volume are properly used.

Container Dimensional Flexibility

At ship-to-shore and other handling interfaces, there are a variety of adequate methods for transferring both loaded and empty containers of variable lengths (see APJ Report 504-301). The evolution to a third generation of push-button control is in the offing and will certainly come about as the cost advantage of introducing containers over breakbulk diminishes through the essential "drying up" of breakbulk cargo. Then, one container service will be competing with another container service, and the weight-cube ratios will then come into play as determinants. Therefore, the shipping lines of the third generation container era must look forward to handling a diversity of sizes of containers, and containers which are under "pool" or interchange agreement.

It can be concluded that, from the standpoint of the shipping industry, widths will remain constant, while lengths will converge on a series of relatively compatible standards. Heights however may, without significant loss be varied in accordance with the commodity requirement. The chief limitation on height is of course ingress and egress. The "low boy" or gondola container may be of heights which are below the standing or working heights of men and forklift equipment. From a practical standpoint this means that we will have wide variations in open and pallet type containers in the "low height" category-and these will be pallet or open configurations. There will indeed be variations in heights in and around the nominal 8' module. To go much lower is to court incompatibility with forklift truck and other "inside" handling equipment; to go much higher is to introduce stacking and handling difficulties. However the clear recognition that volume may be varied plus or minus 6 percent around 8 feet by a simple half foot change in height is a fact which cannot be ignored.

The conclusion of this brief analysis is that the container width dimension standard will receive minimum or no violation; the length considerable violation, but always in modules, and there will evolve two benchmarks around which heights will vary. The first at the 8 foot mark with a tolerance of plus or minus six inches. The second will relate to open or platform containers in the approximately 4 foot height dimension.

The aforementioned description of container alternatives are typical of those presently commercially available. The precise mix and dimensions are selected by the carrier after an analysis of his trade route requirements. Such trade route requirements are

comprised by first, legal restrictions and secondly, by the desire of the carrier for ultimate complete flexibility of his service. In practice, the short run competitive advantage of containers which are well adapted to the trade route and its legal environment have tended to be supervening. Standards, internationally agreed upon, are advisory and hence are effective only to the extent that they coincide with the interest of given carriers. Thus, the 8'x 8' cross section of USASI and ISO have been challenged by the actions of carriers who have found 8' 6" more efficient, and it is not surprising that the ISO recently changed the eight foot high standard for the 40 foot container to eight and a half feet. Similarly, the length modules are, as discussed above, similarly subject to trade route implications. The "standard" elements that have survived are the USASI/ISO cargo fittings and the eight foot width dimension; the first because of its engineering convenience and the second, primarily because of highway restrictions.

The effect of non-standard containers on the current military distribution system relates primarily to the various types of shipping modes used for their transport. It is apparent that economies and increased efficiency which can result from standardization, for example, large-scale container pooling, cannot be obtained by the military until this problem has been resolved. In the Vietnam operation, the Department of Defense used a contractor with equipment which did not conform to USASI/ISO standards. However, as this was the only type of container used and he provided the containerships and chassis required, problems resulting from the use of non-standard equipment did not occur. However, had it been necessary to use more than one contractor, inefficiencies would have resulted from introduction of two

different types of containers into the theater. This is a consideration which must be taken into account in future planning.

Certain other lesser problems and limitations exist in current containers. One is the requirement for dunnage to hold cargo in place and prevent shifting during transportation. Currently, wood is the most popular form of dunnage as it can be cut to suit any cargo arrangement in the container. This is time consuming, and may present problems for unskilled personnel. Some containers have tiedown rings located on the sides of the containers and recessed into the interior walls which can be used for tiedown rope or wire lashing. Also, in some containers horizontal or vertical tracks are recessed into the interior container walls to accommodate restraining bars which prevent cargo from shifting during normal operating conditions. Pneumatic dunnage, using air inflated pillows has been developed but has not been fully accepted to date. It is a satisfactory means of preventing cargo movement and requires less labor for installation than wooden dunnage. However, the initial investment is higher than for wood and a control system is required to insure that the inflatable dunnage is returned with the container.

Current commercial containers are designed solely for cargo carrying. Had containers been considered for the other uses discussed in Chapter 2, some modifications would probably have been required. Easily mountable and demountable binning tailored to the container, for example, would permit rapid conversion to its use for binned storage. Removable panels to permit windows, personnel doors and skylights, and movable compartment dividers would permit rapid use for administrative purposes.

FACILITIES

The military facilities primarily affected by container movements are depots and ports, (sea and aerial). Military container movements normally originate and end in depots, and for transoceanic movements pass through an aerial port or seaport at either end of the voyage.

Depots

Military depots serve as cargo consolidation points, from which cargo is packed for shipment and into which cargo is received for storage. The impact of containerization on military depots relates both to the physical requirements of the depot and to depot operations.

Large scale container operations establish a requirement for a depot marshalling area for locating containers waiting to be stuffed or unstuffed prior to their movement from the depot. As noted above, this requirement carries with it the requirement for the necessary materials handling equipment to handle the container in the yard and other depot areas. An effective marshalling yard must be sufficiently large to accommodate the number of containers related to the depot receiving and shipping rate, must be hard stand and have paved access to and from the areas where the actual stuffing and unstuffing is accomplished.

Maximum effective use of the containerization concept may also have some impact on normal depot procedures. The concept of container packing for throughput to the most forward distribution point, such as discussed for rations and some other commodities earlier, will require selective planned packing of containers.

Similarly, block stowage in containers, as discussed earlier, may also require some changes in depot receiving and shipping. Packing and packaging requirements for container shipments may also be different than for breakbulk. Other areas of impact fall mainly in the control and documentation procedures discussed elsewhere in this report.

The lack of depot facilities, roads and hardstands in the early days of the Vietnam operation would have made depot handling of containers extremely difficult. The required marshalling yards and loading ramps were unavailable, as the MHE equipment which could have substituted for loading docks. Thus, both container movement within the depot areas, as well as container stuffing and unstuffing would have presented serious problems. These conditions show the need for preplanning before moving into full containerization. Such plans must particularly consider local resource availability. For example, the shortage of crushed rock in the Da Nang area had a serious effect on operations there. Preplanning will lead to prompt actions to resolve such problems and permit early introduction of container movements to the area of operation.

Some problems in depot facility capability to meet containerization demands have continued throughout the Vietnam operation. One encountered, both in CONUS and Vietnam, was the match of the container floor heights when mounted on chassis, to the height of the loading dock. In many instances, the container floor height and dock height were not compatible and dock boards were required to permit material handling equipment to enter the container from dock level.

A second problem also related to loading docks, has been encountered in Vietnam. The number and location of loading docks in some Vietnam depots limited containerized cargo operations. In many cases, only one dock was available to serve all warehouses in a depot. The physical separation of the dock from the warehouse area and the fact that most warehouse areas were at ground level resulted in multiple handling of cargo. Thus, incoming cargo was removed from the container to the dock by forklift, loaded onto another vehicle for movement to the warehouse storage location, unloaded and stored.

In some forward distribution points, containers arrived at unloading points where no offloading docks were available, nor any other means of entering the container with material handling equipment. In these cases, it was necessary to use a winch or manual labor to move cargo from the front of the container to the rear door and then move from that point by forklift truck to the storage location. Problems of this type obviously reduced the effectiveness of the container in its primary capability to produce short turnaround time and must be considered in any deployment planning involving the large-scale use of containers.

Ports

Seaports

The effect of containerization on port facilities is similar in some respects, to its effect on depots. Ports also require a marshalling yard for the holding of containers prior to loading and after unloading until departure from the port area. As with depots, it is necessary

that these areas be of adequate size, paved, and have paved access roads to the pier area.

Deep water piers are required for the handling of oceangoing containerships, and with the continuing expansion in the size of these ships, adequate pier size must be provided. As noted earlier, it is desirable that piers include a RO/RO interface.

While the requirement for marshalling areas, and areas for stuffing and unstuffing containers (when that function is accomplished at the port) represent increased space requirements in the facility, the major overall impact is one of reducing space requirements for a given throughput. The rapid movement of containers through a port reduces, to a major extent, the space required for storage and transfer sheds, thereby eliminating many of the conditions causing pier area congestion. The use of containers permits the location of receiving areas further from the pier complex and permits a steady through flow from ships to consignee, by a distribution count rather than the time-consuming item count.

Additionally, the rapid turnaround of containerships noted earlier, is a major factor in reducing hold time of ships awaiting unloading. The introduction of Sea-Land Container Service to the Naval Supply Depot at Subic Bay provides an excellent example of the impact of containerization on port facility requirements.1/

1/ Briefing to JLRB by Naval Supply Depot, Subic Bay.

The Supply Depot, just prior to initiation of Sea-Land container service had problems of pier congestion and studies were underway to build a second transit shed/pier complex. The introduction of container service allowed the terminal complex to distribute tremendously increased amounts of cargo without a substantial facility building program. The plan for a second pier complex was shelved largely as a result of containers. Additionally, the port no longer had ships in "hold" status awaiting discharge and was able to expand its consignees to include all of Luzon.

Large-scale intermodal container operations through ports in Vietnam would have been impossible in the early stages of the Vietnam buildup. The lack of deep-draft berths, adequate piers and similar problems have been discussed previously. It is apparent that rapid container operations in a deployment situation must consider these problems and ways to resolve them promptly must be found. At the present time, port facilities in Vietnam are adequate for handling container shipments and, as noted in earlier chapters, under a full containerization concept would be more than adequate.

Aerial Ports

Requirements for container handling at aerial ports are similar to those at sea-ports. Marshalling yards and access routes are required, as are areas for stuffing and unstuffing containers, if this function is accomplished to any extent at the port. Cargo handling equipment capable of loading, unloading and moving containers must be available. As with

seaports, the large scale use of containers will eliminate many areas and facilities now required for intransit cargo handling and should produce a more efficient port operation, by reducing the amount of space and turnaround time of aircraft. With the advent of large aircraft, and the probable major increase in airlift of cargo, large-scale container operations must be included in airport facility planning.

Although no significant amount of cargo was shipped to Vietnam in containers by air in the 1965-1968 time period, their use would have been highly desirable. There was a high degree of congestion at the Vietnam air terminals, particularly during the early part of the buildup period when only the Tan Son Nhut airport was capable of receiving large aircraft. The shortage of long range, heavy lift aircraft demanded that the available aircraft be rapidly loaded and discharged to maintain high aircraft utilization. The rapid cargo handling that could have resulted from the use of large containers was denied because of the inability of the aircraft to carry the large vans.

SYSTEM-WIDE CONSIDERATIONS

While this chapter has discussed equipment and facilities in terms of individual nodes and legs, it must be recognized that the design of equipment and facilities used for military transportation and distribution functions must be based on system-wide considerations. This is particularly true for basic decisions taken early in the concept formulation, definition and development stages.

The advantages and limitations of materiel used in Vietnam reflected, in most cases, decisions that had been made many years before. Short-term improvements were limited to auxiliary equipment and features, e.g., the installation of oil bath filters to extend the life of engines operating in severe dust conditions. Operational readiness of many items was maintained by the extensive use of both military and commercial technical representatives. It became clear that knowledge of the natural and induced environment seen by logistic materiel is essential to designing for effective operation and satisfactory service life.

Data regarding natural environments, particularly for weather, were generally available. On the other hand, quantitative information on induced environments, for example, shock and vibration, experienced by the equipment doing its job in the natural environment, required improvement. That this situation applied to containers was evident in commercial operations during the Vietnam era when there was lively controversy between insurance companies, who could point to instances of container damage, and the transportation industry, who maintained that containers reduced transportation damage, and hence that insurance rates should be lowered.

The need for better specifications, based on improved knowledge of the transportation environment, was recognized both in Government and industry. Thus, the Milvan Operations Plan for test and evaluation of military controlled containers included as an integral part of its evaluation program, measurements and observations of the response of the container and its cargo to the natural and induced transportation environment.

A knowledge of the transportation system environment is particularly critical to container operations because as the uniform intermodal denominator, the container moves from depot through linehaul, to domestic port to far shore distribution systems. It experiences not only individual environments, but more important, combinations and sequences of environments. Thus, mechanical racking that may loosen a seam at one point of the cycle will permit rain damage at another. Combinations of shock and vibration at each mode either risk damage to cargo or require expensive cargo packaging. From the point of view of the Defense Department, transportation and packaging technical characteristics and costs are in a tradeoff. Therefore, a precise understanding of transportation environment is necessary for proper design and procurement decisions. By 1969, conferences had been held which called attention not only to the need for better environmental information related to hazardous materials but also for data applying to all movement of materials.

System-wide implications of containerization also became clear in the facility construction area. For example, warehouses in Vietnam were typically designed as ground level installations, frequently without aprons or loading docks. A result was that depot commanders installed centralized loading docks for the discharge of incoming cargo and its redistribution to storage areas. This process implied a double handling and movement of cargo over extended distances within the depot area, with a consequent increase in manpower requirements and in the operating cost of materials handling equipment. Under condition of breakbulk operations

with mixed loads, the penalty may not have been excessive because of the opportunity afforded to sort the cargo at loading dock for redistribution to individual storage locations. However, with containerized operations, in which a complete load will frequently be directed to a single storage point, such an operation would be inefficient.

Containers also affect facility layout, producing requirements for appropriate large hardstand areas, adequate aisles, and roadways capable of withstanding loaded container chassis. Thus, large-scale use of containers would have altered not only the quantitative requirement for ports and depot facilities in Vietnam but also their detail design and configuration. Hence, the container implies a system-wide engineering approach to facilities.

The standardization of corner fittings and limited set of applicable dimensions of intermodal containers also make it necessary that equipment designers consider the entire transportation environment in designing container handling equipment. While there are wide ranges of alternative handling equipment possible, military requirements make it essential that the detail characteristics do not limit equipment operation to a particular geographical area or range of environmental conditions. The same materials handling equipment used in a CONUS terminal must be capable of operating effectively in any of several overseas areas, each with its own set of natural and induced environments.

The area of packaging, although not specifically a concern of this study, is strongly impacted by container system characteristics. Container weight and volume utilization

require not only the adaptation of container overall dimensions to a limited standard family, but a corresponding adaptation of packaging configuration and design. In many instances, the level of pack and the cost of the package itself may be greatly reduced by recognizing that the item will be moved in a container without intermediate handlings. Protection can therefore be concentrated on withstanding the natural and induced environment of the user.^{1/} Modern supply support management computer system capabilities permit automated individual tailored decisions with regard to shipping mode and environment, and such decisions can be incorporated in the procurement decision logic used by material managers. Here again, a precise knowledge of the system-wide characteristics of the transportation environment are essential to sound decision-making.

In summary, while containerization was compatible with much of the technology of the Vietnam era, there are opportunities for increased effectiveness and major cost savings through the acquisition and application of reliable data covering the transportation environment in the light of the costs associated with technological alternatives.

Note on Data Sources

The information contained in this Chapter was obtained from many sources. Intermingling of source data and integration with cross checks made footnote recognition of each source impractical. It is only possible to note some major references, and the use of this material as well as other data from sources not listed is acknowledged.

^{1/} Recognition must be given to the fact that certain items will only go as far as depots and be redistributed. Other cargo may go directly to the user in the original container.

1. Sealift Requirements Study Progress Reports, Long Range Objectives Group, Office of the Chief of Naval Operations, Department of the Navy.
2. "Container Ships", James J. Henry and Henry J. Karsch, The Society of Naval Architects and Marine Engineers, Publication No. 8, October 24 1966.
3. "The Containerization Revolution - Its Military Impacts", a research paper prepared for the U.S. Command and General Staff College by Major Richard E. Stephenson, 12 April 1968.
4. "Containerization" by Doug Schweitzer, Department of Civil Engineering, University of Saskatchewan, January 1969.
5. USAMC Technical Report 69-19, "Admiral Callaghan" Cost and Performance Evaluation, James E. Rose, Jr. and Frank Quinn, U.S. Army Material Command, June 1969.
6. APJ Report 504-301, "U.S. Army Cargo Containerization Requirements", August 1968.
7. APJ Reports 589-201 through 589-209, "Containerization Engineering Evaluation", December 1968.
8. U.S. Navy MSTS Presentation for the JLRB, 19 June 1969.
9. MSTS Containerization Briefing to JLRB, 31 July 1969.
10. Navy Containerization Briefing to JLRB, 2 October 1969.
11. Naval Supply Depot, Subic Bay Briefing to JLRB (date unknown).

12. Naval Support Activity, Da Nang, Presentation to the JLRB, 15 September 1969.
13. MTMTS Briefing, "The Vietnam Period", to JLRB, 10 June 1969.

CHAPTER 5
MANAGEMENT AND CONTROL
DURING VIETNAM ERA

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GENERAL

This chapter discusses the management and control aspects of containerization within the Department of Defense (DOD) component commands and agencies in support of the Vietnam military operations during the period 1965 through 1968. Its purpose is to review these management and control aspects and to identify and document the significant lessons learned as a basis for future courses of action.

The following specific areas are treated:

1. National and DOD containerization to include policies and related uses of intermodal containers
2. The major management and operating systems which may be affected by the introduction of the intermodal container into the DOD logistics systems.
3. Considerations affecting organizational interfaces resulting from the throughput feature of the intermodal container.

Although it is not intended to duplicate in this report the JLRB assessment of transportation and distribution management and control covered in Chapters 2 and 4 of the JLRB Transportation Monograph, some overlap cannot be avoided. Basic features of the DOD logistics management concepts covered in the Transportation Monograph are addressed herein, but only from the standpoint of containerization.

ISSUES

The following issues are considered pertinent.

1. National and DOD intermodal container policies.
2. Identification of key MOD management and control concepts required for containerized cargo operations.
3. DOD control and documentation policies related to containerized cargo operations.
4. Accounting and performance reporting of containerized cargo movement.
5. DOD policies for coordination of military containerization with industry.

CONTAINERIZATION POLICIES

U.S. Government

As stated in JLRB Transportation Monograph, Chapter 2, Transportation Policies, Organizations and Missions, there is no single statement of national policy applying to all transportation modes. The "National Transportation Policy of the Congress", as stated in the Transportation Act of 1940, applies to domestic surface transportation. A series of other policy statements exist pertaining to civil aeronautics and to the merchant marine. However, no announced policy by our Government dealing specifically with intermodal containers, as such, can be found.

The Interstate Commerce Act, with its five parts, plus the Transportation Act of 1940 and the Federal Aviation Act of 1958 have tended to orient the national transportation policies and federal regulatory agencies to the various transportation modes that make up the total national transportation capability. However, this orientation poses problems

to equipments and techniques that do not fit into these conventional categories.

The "layering" concept of the national transportation policy formulation geared to breakbulk operations produced constraints and barriers among the various entities of the transportation industry as the intermodal container raised throughput implications. Thus, the railroad-owned motor carriers (for example) are permitted only a limited operating authority restricted to rail-related traffic; freight forwarders may not acquire control over common carriers; railroads may not own an interest in a barge line, etc. However, the container is forcing a whole series of decoupled transportation modes into an integrated system of operation.

Military Containerization Policy

A review of DOD and Service programs, directives and regulations dealing with material storage and distribution reveals that the intermodal container has not been identified as a special or peculiar aspect of logistics operation. The only specific policy directive at DOD level directly relating to intermodal containers pertains to container volume utilization, establishing an 80 percent goal.^{1/}

However, the DOD Directives relating to the selection and management of transportation resources and directives relating to unitization, provide a sound basis for extension of policy to the intermodal container. These regulations recognize the concept of moving the load in an unbroken state from source to distribution point or user where it will meet the user's requirements with overall economy compared to other methods.

^{1/} DOD Cost Reduction and Management and Improvement Program, Phase II-Goals, ASD(I&L) Letter, dated 11 March 1969.

Containerization, as such, is not new to the DOD. Methods of containerizing cargo have been in effect for many years, including the use of the Conex, the Seacon and consolidation containers such as the tri-wall and others. However, these containers all were moved in the common-user DOD cargo distribution system as an item of breakbulk cargo, rather than as a throughput intermodal container operation utilizing special containerships. Of all containers used by the DOD, the Conex was the most universal, and provided major support to the Vietnam operation.

Although no other DOD policy directives could be found that outlined criteria for use of the intermodal container, basic policy directives under which such containers would be used are covered below.

1. DOD Directive 4500.9 "Transportation and Traffic Management" states:
 - a. "DOD transportation resources shall be so organized and managed as to insure optimum responsiveness, efficiency, and economy in support of the Defense mission."
 - b. "There shall be maintained and operated, in peacetime, resources to meet approved DOD emergency and wartime requirements, having due regard for available commercial transportation."
 - c. "The means of transportation selected shall be that which will meet DOD requirements satisfactorily at the lowest overall cost from origin to final known destination (in CONUS or overseas)."

2. DOD Instruction 4100.36 "Cargo Unitization" is applicable to cargo unitization in terms of:

- a. Palletized unit loads
- b. Consolidation containers
- c. Conex
- d. Seacon

It states:

- a. "The fundamental objective of cargo unitization is to increase the speed, security, accuracy, flexibility and economy of packaging, packing, supply, storage and transportation operations by reducing miscellaneous small shipments to homogeneous unit loads of optimum size for the direct application of mechanical handling equipment."
- b. "A unitized load is the assembly into a single load of more than one package of one or more different items of supply in such a manner that the load can be moved in an unbroken state from source to distribution point or user as far forward in the supply system as practical."
- c. "Maximum use will be made of unitized loads where such use will result in an overall economy to the DOD as compared with other methods."

In spite of the current lack of published directives relating directly to the intermodal container as such, much effort and consideration has been given to the subject by OSD and other DOD elements. Actions have been taken, positions stated and questions raised at many levels related to the problems and potentials of containerization. Some of the more important examples of policy type considerations, as set forth by various DOD elements, are summarized in the following discussion.

Policy Considerations - OSD and JCS

1. In a review of the merchant fleet in support of DOD requirements, the Director of Transportation and Warehousing Policy, OSD, advised the materiel Secretaries in April 1969 that:1/
 - a. MARAD indicated in 1968 that most general cargo moving between U.S. and Europe would be containerized by mid-1970.
 - b. By 1975 it was anticipated that many of the breakbulk ships would disappear from the U.S. merchant fleet inventory.
 - c. Commercial ocean distribution patterns are between major terminals which favor large (jumbo) non-selfsustaining containerships.
 - d. If the trend continues, it may result in a U.S. merchant fleet that would not meet DOD contingency requirements.

2. In his letter to the JLRB Chairman dealing with suggested areas to be considered for change, development or in-depth review, the Director of Transportation and Warehousing Policy, OSD, stressed the following containerization related areas.2/
 - a. Use of containers as a means to provide balanced supplies such as mixtures of subsistence to form rations or mixtures of packaged oils and lubricants to support truck or tank units.
 - b. Use of containers for preloaded bin stocks ready for immediate deployment.

1/ Briefing by Director, Transportation and Warehousing Policy, OSD, to Materiel Secretaries, 22 April 1969.

2/ Letter to General Besson from V. F. Caputo, 13 March 1969

c. Requirement for:

- (1) An in-depth review and investigation to determine to what extent increased use of containers for airlift to contingency areas could increase the effectiveness and capability of aerial ports of embarkation and in-country distribution systems.
- (2) An in-depth review and investigation to determine if contracting of containership service into a contingency area should be considered for future use earlier than was the case during the Vietnam era.
- (3) An investigation of vessel utilization and costs, and the problem of in-theater port congestion in support of Vietnam operations.
- (4) An in-depth review of the entire ocean terminal capability to rapidly offload vessels in-country and to marshal and deliver cargo to consignees.

3. J-4, JCS, in a letter on containerization to the Commanders-In-Chief of the Unified and Specified Commands ^{1/}noted certain problems and areas. These were primarily related to the following topics:

- a. Use of prepacked intermodal containers to enhance unit deployment and readiness posture.
- b. Problems of container use in assault phase and over-the-beach operations (Logistics-Over-the-Shore-LOTS)
- c. Aerial port congestions resulting from the use of large aircraft types (C-5A and others), and the application of containers to resolve this problem.
- d. Breakbulk versus containerships for support of military deployments.

1/ J-4, JCS Letter on Containerization, 4 March 1969

- e. Use of military versus commercial containers, and the impact on mission accomplishment for each alternative.

Policy Considerations -
Unified and Specified Commands

No specific published policy for the use of the intermodal container was found at the Unified and Specified Command level. However, some responses to the J-4, JCS letter on containerization, noted above, give an insight to their current thinking

USCINCEUR^{1/}

Containerization will have a tremendous impact on military logistics. The way in which the container will affect joint logistics, however, will depend on the approach taken by DOD, JCS and the Services.

Containerization has the potential to increase speed and enhance the dependability of the cargo distribution service through intermodal source-to-user movement of large loads. With increased use of containerization, substantial change and improvement in supply distribution and support concepts would be possible and should be investigated.

We must decide clearly what we want to accomplish with the container. We must describe where, how much, when, and in what manner we expect to render support, using the container. We must determine:

1. What is meant by "maximum throughput"?
2. Direct delivery from where to what units?

^{1/} USCINCEUR Reply, dated 10 September 1969, to J-4, JCS Letter on Containerization.

CINCSTRIKE 1/

Commercially oriented container systems do not lend themselves to the mobility problem encountered in joint tactical deployments.

Commercial air cargo containers are inflexible relative to diversified uses.

Smaller sized cargo containers compatible with transportation considerations could be reconfigured, when empty, into such facilities as troop shelters, offices, repair shops and warehouses in the field.

The Strike Command Joint Training mission offers a unique opportunity for testing and evaluation of container concepts and hardware related to joint operations in the field.

USCINCPAC 2/

Containerization should have a significant impact in the area of depot operation and should offer an opportunity to reduce the logistic tail in the theater of operations by reducing manpower, facilities and stockage levels.

Policy Considerations -
Department of Army

The Conex was designed as the largest container acceptable to both military depot operators and the transportation industry. Basically, the Conex was looked upon only as an interim solution until industry would accept a common denominator container that would truly integrate all modes of transportation (intermodal). 3/

1/ CINCSTRIKE Reply, dated 7 August 1969, to J-4, JCS Letter on Containerization.

2/ CINCPAC Reply, dated 7 April 1969, to J-4, JCS Letter on Containerization.

3/ General Besson Letter to President, Grace Lines, 17 November 1966.

Department of Army policy and policy considerations are found, for the most part, at the U.S. Army Materiel Command level. As the Army's major logistics command, it is directly responsible for supply distribution in all its aspects. USAMC Policy Statement 55-4 provides that maximum use will be made of Conex, commercial and Milvan containers for oversea and retrograde shipment of Army-managed materiel.1/

The Army recognizes the need for a strong commercial container industry, and intends to encourage its growth and make full use of it. Army expects to use both commercial containers built to USASI dimensions, and containers that do not conform to those standard sizes but which provide satisfactory service.2/

It is clear, however, that the deployment of a strong commercial container capability requires a determination and acceptance of standards by the transportation industry.2/

The Army welcomes the broadest possible investigation of container standards by the MH-5 Committee. Through its representative on the committee, the Army will gladly participate in its deliberations, including any further consideration of additional container sizes that it may undertake. The Army is obliged to support the findings of the committee as

1/ Ibid.

2/ Gen. Besson Letter to Mr. Hardin, U.S. Steel Corp, 17 Jan 1967

representing the transportation industry's consensus. 1/

The Army must find a large measure of standardized capability to support military operations. This is not just because of the requirement by the Army to provide for the onward movement of commercial containers in theaters of military operations, but also because of the Army's requirement for its own fleet of containers. 1/

Army ownership of containers is inherent in its development concepts of a modern utility logistic system which will place heavy reliance on container shipments into the theater--with some containers retained in the theater for field storage, temporary shelters and other related uses. 1/

Possible uses of containers for non-cargo distribution functions must be explored, particularly as pre-packaged: 2/

1. Fire control centers
2. Command posts
3. Mobile repair shops
4. Communication centers.

Use of containers in a throughput supply system from CONUS depots or factories to field units must be developed. 2/

Policy Considerations -
Department of Navy

The Navy views the concept of containerization as being applicable in two related areas. 3/
These are:

1/ Gen. Besson's Letter to Grace Lines, and to U.S. Steel Corp.

2/ Gen. Chesarek Address to NDTA, Atlanta, 23 September 1969

3/ Navy Containerization Briefing to JLRB, 2 October 1969

1. Point-to-point movement of containerized cargo for normal logistic support employing common user cargo distribution capabilities.
2. Specialized applications to Naval operations.

With regard to the first area, the Navy notes the worldwide adoption of containerization and the resultant reduction of breakbulk cargo shipping, with its limiting effect on options for selection of various transportation modes. The Navy accepts the fact that containerization will play an increasing and major role in our strategic mobility planning.

The technology available in the commercial industry must be fully exploited in the development of DOD container systems, including the design of future ships for MSTC nucleus fleet, as well as ships for amphibious force and underway replenishment forces. Additionally, the Navy must be able to apply container concepts to its organic airlift.

The Navy has adopted the position that the use of containers must be accelerated, where appropriate, and that all Naval commands must be alert to new opportunities for improving combat effectiveness through greater use of containers. Particular emphasis must be placed on special application of containerization in:

1. The conduct of amphibious operations
2. Underway replenishment
3. Reduced requirement for overseas terminals and storage facilities.

The Navy is actively engaged in the application of intermodal containers in support of future

military operations.

Policy Considerations -
U.S. Marine Corps (USMC)

The Marine Corps effort is directed to the development of a family of containers to provide improvements in forward delivery, distribution, temporary storage and field shelters. The Marine Corps is examining current and future application of containerization and actively supports the concept. The primary objectives in containerization are to:1/

1. Develop multi-purpose containers
2. Insure compatibility with the delivery and distribution systems
3. Optimize container usage
4. Exploit and develop means for using containers in undeveloped areas and over-the-beach
5. Study further the use of containers for unit deployment.

Policy Considerations -
Department of the Air Force (USAF)

The USAF fully supports the use of intermodal containers in the surface shipment of Air Force sponsored cargo in the common user DOD cargo distribution system, and is actively engaged in development efforts to provide an intermodal container that will be compatible with airlift restraint requirements.2/

It is the USAF policy to containerize ocean

1/ U.S. Marine Corps Containerization Briefing to JLRB,

2/ Briefings to NDTA Research and Education Council by LTC Dinwiddie and Maj. Miller, September 1968.

shipments to the maximum extent when this method of shipment is cost-favorable or other factors exist, such as the necessity to protect high-value and pilferable material from loss and damage.1/

Policy Considerations -
Defense Supply Agency (DSA)

In response to a letter from the Chairman of the JLRB, the Director, Defense Supply Agency recommended 31 proposed changes or in-depth reviews in the existing Defense logistics systems, including a recommendation to increase the use of intermodal containers.

Policy Considerations -
U.S. Army 1st Logistical Command

The Commanding General, 1st U.S. Army Logistical Command, U.S. Army, Vietnam, in his response to the JLRB Chairman, supported a high level of containerization because of reductions in security, care and preservation and pilferage problems resulting from container use.

Policy Considerations -
Military Sea Transport Service (MSTS) 2/

The Military Sea Transport Service (MSTS) has pursued the policy of providing ocean container services where and whenever:

1. Such service is requested by the shipper organization, and/or
2. Such service is superior in terms of cost and consignor/consignee acceptance over other commercial methods.

MSTS has concluded that exclusive container service contracts are not justified to areas

1/ HQ. USAF Container Study, 30 June 1969.

2/ MSTS Containerization Briefing to JLRB, 31 July 1969

where adequate container service is available from various sources, and where peacetime conditions exist. Exclusive contracts are only justified when no, or insufficient, container service is available or wartime conditions indicate a need for a dedicated container service.

Policy Considerations -
Military Airlift Command (MAC)

No specific statements or proposed position papers issued by the Military Airlift Command (MAC) were found. However, MAC and the Director of Transportation, Hq, USAF, have been working actively to improve unitization of airlift cargo.

Policy Considerations -
Military Traffic Management and Terminal Service (MTMTS)

Military Traffic Management and Terminal Service (MTMTS) in their briefing to the JLRB stated that:

1. Greater use must be made of containers in vendor export shipments. This will eventually be accomplished principally through greater availability of containers and through contractual arrangements which will permit final packaging determination as late as 10 to 15 days before shipment.^{1/}
2. Shippers and traffic managers must think in terms of the total transportation system rather than individual segments.

^{1/} MTMTS Containerization Briefing to JLRB, 3 September 1969

MTMTS made the following points concerning containerization in a briefing to ASD (I&L):^{1/}

1. MTMTS will stress the use of commercial container services to the maximum extent possible to satisfy DOD requirements when operationally required or when their use is cost favorable.
2. Each military Service must continue to exercise its assigned responsibilities for requirements determination, funding, procurement, maintenance and inventory control over Government-owned containers required for purposes peculiar to the Service.
3. DOD should develop "Through Intermodal Container Operations" (TICO/TGBL), which permits a shipper to stuff his cargo into a container at an inland point, pay the carrier a single factor rate for delivery intact, at the final overseas destination.

The above discussion shows the major areas of concern, and thus areas of policy consideration, in the cargo distribution function as affected by containerization. Probably most important are the problems of ocean lift to meet future military requirements, the most effective military use of containers and container standardization and intermodality.

Figure 5-1 summarizes the above review, showing for each agency, the policy areas it considered important. The concern of most agencies with the core group of major problem areas is clearly shown in this matrix.

^{1/} MTMTS Containerization Briefing to ASD (I&L), December 1968

Agency	Policy Area Considerations										
	Adequacy of Future Ocean Lift	Use of Containers	Container Standardization	Military Ownership	Throughput System	Central Coordination and Control	Consolidation/Distribution Centers	Intermodality of Containers	Containers in Assault Phase & LOTS	Documentation	ADPE & Commo
Dept. of Trans.											
OSD	x	x		x	x			x		x	
J-4, JCS	x	x	x	x	x	x		x			
USCINCEUR	x	x					x				
CINCPAC		x		x		x					x
USAMC		x	x	x	x						
Dept. of Army		x	x	x	x						
Dept. of Navy		x									
U.S. Marine Corps	x	x									
Dept. of Air Force		x									
DSA		x									
U.S. Army 1st Log.Cmd.		x			x						
MSTS		x			x						
MAC		x			x						
MTMTS		x		x	x						

Figure 5-1. Matrix of Containerization Policy Area Considerations

With Agencies Identified

MANAGEMENT SYSTEMS

General

In the following discussions, current DOD management systems and concepts are assessed, primarily to determine to what extent, if any, they will be affected by containerization. The following key management elements are considered:

1. Control of military and commercial intermodal containers used in the DOD logistics operations.
2. Command management accounting structures and performance reporting
3. Effect of containerization on management concepts and systems.

Control of Military and Commercial Containers

Management concepts for physical distribution within DOD have been covered in Chapters 2, 3 and 4 of the JLRB Transportation Monograph. These concepts are repeated in this report only when they relate to containerization. In discussing management and control as related to containerization, a distinction must be made between the management of the intermodal container fleet and the management of the cargo movement itself, although overall logistic management must consider both of these operations and their interfaces.

In October 1967, the Assistant Secretary of Defense (J&L), Supply and Services, proposed the establishment of a Program Coordinator (MTMTS) for containerized shipments. The JCS in February 1968 however recommended that the containerization programs be carried out by means of cooperative efforts

among the DOD components concerned. Therefore, no single intermodal container coordinating agency was established within the DOD.

Current DOD Cargo Distribution Management

Because of the many factors and competing elements involved in the movement of DOD cargo it is necessary that some type of coordination be provided. These coordinating functions are most commonly referred to as Movement Control and are performed by such agencies as MTMTS in CONUS, and by Transportation Management Agencies or Movement Control Groups in the theater. Although somewhat oversimplified, this management system is illustrated in Figure 5-2.

During the Vietnam era, no military-owned intermodal containers were used. However, over 200,000 Conex containers were used by the Army, from which some management systems lessons can be drawn.

Centralized property accountability and control of the Conex fleet was exercised by the Joint Conex Control Agency (JCCA) at Tobyhanna Army Depot. This agency was assigned the task of managing the "box" or cargo envelope but not the movement of cargo. As the Conex moved as break-bulk cargo, this did not pose the problems of precise orchestration envisioned in the use of the intermodal container (chassis-container-named vessels-bogies-maintenance complex).

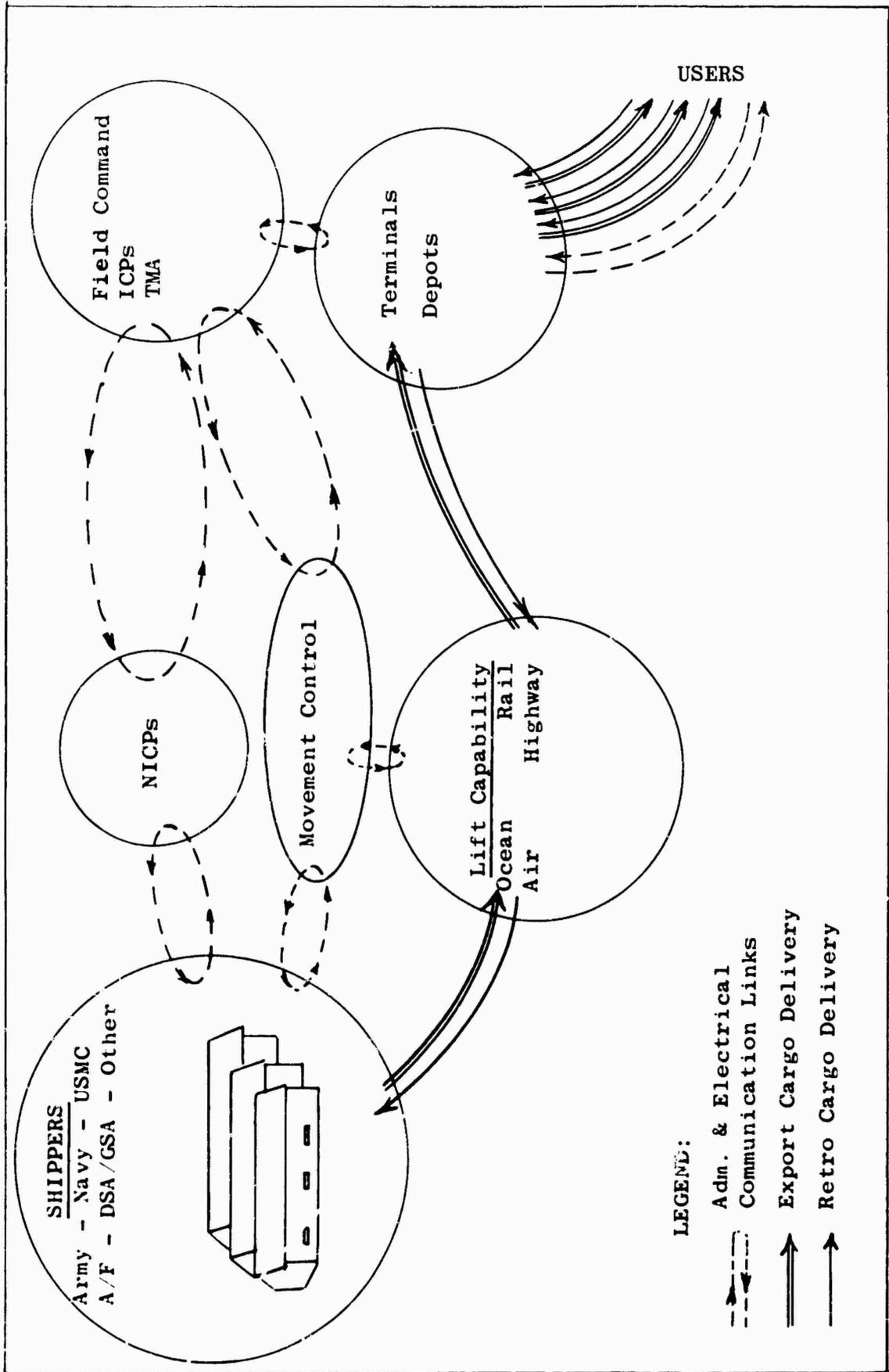


Figure 5-2. Schematic of DOD Cargo Distribution System

Conexs were usually retained at key cargo movement installations in CONUS and overseas (depots and terminals) and were re-distributed to various shipper activities upon requests placed on JCCA or the overseas Conex control officer. Although this system worked, JCCA response to demands for a single or a limited number of Conexs (as contrasted with a large block of Conexs) was always a problem. Also, the procurement cost of the Conex was often amortized by one or two shipments. This led to frequent questioning of the need for a centralized management system, a point that was never resolved. In 1966 the Commanding General of USAMC directed discontinuance of serial number control of Conexs in RVN; however, it was retained in Europe. Thus, JCCA would record only the departure of Conexs from CONUS to RVN and would pick up control only when, and if, the Conex returned to CONUS.

DOD policy on unitization and palletization emphasized the objective of economics in cargo movement by Conex container. Initially, a DOD directive^{1/} established five dollars per pound as the minimum value of cargo to be considered for Conex shipment. This requirement was later decreased to one dollar per pound at the request of the Department of Army, so that other benefits from shipping in the Conex could be obtained. In the early Vietnam period DOD policy also specified a minimum of 80 percent Conex volume utilization. In July 1965 the Department of Army obtained a reduction of this minimum to 60 percent, a value usually exceeded.

1/ DOD Instruction 4100.36

In July 1965 the Army established a policy of maximum use of the Conexs for shipments to Vietnam in an effort to expedite port clearance, inland movement and to facilitate storage of material.

The lessons of the Conex experience may be summarized as follows:

1. Management, control and policy must be system-wide. Thus, economic penalties at one location (e.g., additional cost) must not be permitted to frustrate overall gain arising from economies at another point (e.g., reduction in port handling cost).
2. Arbitrary restraints based on value of cargo, volume utilization, and similar factors relating to individual aspects of the operation should be introduced only after system-wide analysis of impact has been determined.
3. The intensity of control should be related to the value of the container and the total economics involved in its use.

Need for System Management

USCINCEUR stated: "To effect maximum utilization of containers for logistic resupply during contingency operations, control of container assets would be required to locate and relocate containers to meet the logistic needs of those Services involved. Prepacked containers utilized in rapid force deployment should be controlled by the unit or Service responsible for that force deployment. Distinguishing

between the two types of container utilization would be the key to control and the degree of control required.^{1/} The possible need for centralized staff direction of the DOD containerization program will be discussed further in the sections on Operating Systems and Organization and Missions below. However, it appears that the present segmented and transportation mode oriented approach to containerized cargo movement management tends to mitigate against the attainment of overall cost and effectiveness benefits. Increases in efficiency of the total system may be attained through increased expenditures at the expense of a single node or leg in the system. For example, the CONUS depot may incur extra costs in container stuffing in order to attain cost savings and reduction in delivery time in subsequent nodes and legs. It is evident that the decision to expend these depot funds (which are allocated vertically through the command operating program and budget structures) in order to realize a reduction in CONUS ocean terminal or ocean transportation costs, will require a most viable integrated systems management concept.

The foregoing indicates a need to distinguish between operating management making the immediate decisions in a most direct and effective way and performance management dealing with moderately close horizon balancing the use of the respective transportation modes and other activities in the throughput system. Finally, the distinction between the two preceding management categories and policy guidance with its long run horizon makes it possible for the common user transportation/distribution systems managers to "drive" the overall system in the desired direction.

^{1/} USCINCEUR Reply, dated 10 September 1969, to J-4, JCS, Letter on Containerization

Changes and Trends in Containerized Cargo
Distribution Management Concepts

Observations made by field commands and by single manager transportation elements in the areas of containerized cargo distribution reflect a keen awareness of the changes and trends in the physical distribution management concepts. Those that will require particular DOD attention during the next decade are summarized below:

1. Some uncertainties still surround containerization within the military establishment. This especially concerns standards of container sizes, interchange and sharing of containers, how to handle the rate structure, empty retrograde movement of containers, labor problems, and container ownership. This point is consonant with the repeated suggestions that a well thought-out series of test programs are essential to provide factual bases for decision to establish the necessary basis of actual experience.
2. The need to insure that established distribution management principles are followed as DOD moves from the breakbulk to the containerized method of cargo distribution. In transit time must be included throughout the system and not just a segment thereof. Provisions must be made for selective and orderly introduction of material into the system. Systems control must exist which will allow for easy identification and location of intransit materiel including diversion at any point. Containerization can only be adopted by the military establishment if it permits the user of the system to reduce his investment in people,

inventories, equipment and facilities. Also, any new concept of military cargo distribution must insure that flexibility and capability are maintained and not degraded by incompatibility of new systems with military needs.

3. The current logistic planner needs knowledge and understanding of container development and usage beyond that which he has today. Especially, he must acquire greater knowledge in the use of intermodal containers in underdeveloped areas, the use of intermodal containers for air/surface operations, types of cargo and unit equipment suitable for containerization, the impact the container will have on the use of modular features as a possible link between the wholesale and the forward retail cargo distribution operations.
4. Personnel training must be instituted, viewing the container as an integrated system, an important part of the total distribution system, and not merely as an instrument of transportation. This training must include personnel concerned with shipment planning, packing and packaging, container stuffing, port handling, cargo receiving, documentation, stock control and container control and management functions.

Command Management Accounting Structures

The intermodal container affects many basic logistics concepts, organizations and procedures within the military establishment. Understandably, current DOD command management performance reporting and accounting procedures are related to operating program elements. Thus, for central supply management and cargo distribution, DOD Instruction 7220.17 1/ directs accounting and reporting on cargo movement in the following basic areas:

1. Property receiving
2. Packing and issue
3. Shipping
4. Preservation and packaging
5. Traffic management
6. Transportation services.

A review of the depot accounting and performance reporting procedures of the Army 2/ and DSA 3/ indicates that costs and manpower involved in depot receipt and shipping

1/ DOD Instruction 7220.17 "Cost Accounting for Central Supply Management, Industrial Preparedness and Terminal Operations."
2/ Army Regulations 37-100-69 and 740-6.
3/ Defense Supply Agency Manual 7000.1

operations do not relate to specific transportation modes used (such as railcars or highway vehicles), or to an identification of intermodal containers, where used.

MTMMS Traffic Management reports also do not include container movements as a reporting element. For example: MTMMS Quarterly Progress Report contains statistics on CONUS freight traffic by the following categories and methods:

1. Rail (C/L) and (LCL)
2. Highway (T/L, Driveaway, Towaway, LTL)
3. Water (barges and ships)
4. Railroad express
5. Freight forwarders
6. Air freight
7. Air express
8. Air forwarders
9. Bus.

Container movements are not included as an identifying-reporting element or sub-element.

The accounting structure established for the CONUS water terminals under the Industrial Fund however, does contain provision for container operations. DOD Instruction 7220.17 requires that waterfront container operations be carried as a special category.

Performance Evaluation and Planning Factors

In addition to the above directives on accounting and reporting of cargo movement in general, DOD Instruction 5010.25 ^{1/} provides for the reporting of the utilization of intermodal containers in such gross terms as:

1. Percentage of container shipments of total containerizable cargo.

^{1/} DOD Instruction 5010.25 "Logistics Performance Management and Evaluation System-Procedures and Reporting Instructions."

2. Percentage of container volume utilization.
3. Percentage of containers stuffed inland and at tidewater areas.
4. Average movement time from CONUS origin to oversea ports.

Although this is the only performance report specifically related to containerized cargo movement, staff personnel in DOD components and agencies recognize the need for the development of additional and more refined performance and cost planning factors. They universally express a need for better planning factors for the management of the DOD cargo distribution system and stressed that the DOD has no conclusive quantitative dollar values upon which monitoring factors could be developed for use in traffic management decisions.^{1/}

The USAMC Milvan Pilot Operation, which was planned to have started in April 1969, would have provided a sound and practical base upon which to develop planning factors required to formulate program changes in such areas as the use of Government-owned vs. commercial container fleets, development of realistic container rates, reassessment of manpower requirements (particularly at CONUS and oversea water terminals), establishment of criteria for selection of containerized cargo, need for change in MHE and facilities, and others. Certainly, this operation has objectives which, if attained, will provide the DOD and JCS a basis for making dramatic progress in the field of containerized cargo distribution within the military establishment.

^{1/} J-4, JCS Letter on Containerization, dated 4 March 1969, and MTMTS Containerization Briefing, 10 June 1969

The USAMC Milvan Operation is an operation - not a study - and is the only significant container effort for the near future that appears to be capable of supporting advances in concept for all military container operations. Unfortunately, the operation has slipped due to Milvan procurement problems and has been deferred until sometime in mid-1970.

Because system-wide effects must be balanced against cost and performance experience at individual nodes, there is a clear requirement for a consistent and reliable tracking of data on each category of use of intermodal containers. While the basic cost and accounting structures must, of course, be compatible with DOD cost elements, these should not preclude consideration of a consistent comprehensive set of elements related to container operations which can be used singly and in combination for a system-wide analysis. It is perhaps unnecessary to restate that certain of the data elements are likely to be more stable than others and that there is considerable opportunity for applying modern concepts of variable surveillance depth and intervals.

The capability for temporarily expanding the detail and scope of information permits management to work with current actionable information uncluttered by extraneous "noise".

The objective of such information should be to provide the means for measuring the cost and the effectiveness of containerized operations and to distinguish them from break-bulk. Real cost, time, and other performance data to include technological performance, should be provided for shipments from origin to destination, to include all the nodes which make up the total throughput system.

The large-scale application of containers to missions such as deployment stocks, specialized pre-binned applications, for auxiliary purposes will likewise require the application of rational criteria and of a reporting and evaluation means to insure that the goals of the management are being attained.

It is perhaps noteworthy that in the Vietnam era, the Conex applications for non-transportation use were the result of local initiative, and the effectiveness with which the Conex were used for this purpose were heavily dependent on the Commander and his staff. While this provided broad latitude, there was no ready mechanism for transmitting lessons learned or for improvement of field applications.

Basic Elements of Information

Thus, while DOD operating programs must be managed along command and vertical lines, the throughput visibility of the DOD cargo distribution system is essential in the total management of cargo movement. The

intermodal container has not created anything new in terms of the total DOD distribution management data base. However, the container has pointed out the need for an integrated management system approach.

In the consideration of such an integrated management system, it is essential that the Basic Elements of Information (BEOIs) required be developed with some care. As a minimum, for each node and leg in the transportation/distribution system, and for the system in total, they should provide accurate, usable information for the manager in the following categories:

1. Cost
2. Time
3. Performance
4. Technical adequacy.

BEOIs should be tailored to the specific management levels of policy, performance and operations. In a previous study of containerization APJ established the BEOIs required to provide such information.

Commercial Container Fleet Management

In considering container management systems a review of current commercial intermodal container fleet management is helpful. The rapid growth of commercial intermodal container fleets during the Vietnam era was characterized by ocean carrier operations

in captive systems,^{1/} with little penetration from tidewater to inland areas. Commercial intermodal container fleets are managed by the ocean carrier and are generally positioned throughout his developed trade routes.

A number of intermodal container pooling organizations have been formed. These activities have been created under the concept that the container pool operator would be neither a carrier, nor a freight forwarder, nor a shipper, but an agency completely free from any involvement in transportation itself. They have been formed based on the concept that common container use could help the industry to produce more efficient and economic container operations. Thus, the pool operators are striving to provide worldwide multi-point interchange systems, and to find secondary markets for the use of containers.

Only limited progress was made in the container pooling and interchange operations during the Vietnam era. Non-carrier intermodal container fleet owners were primarily in the container leasing business rather than in the pooling and interchange business.

However, some progress has been made. A basically U.S. domestic organization embracing highway vehicles, the Equipment Interchange Association, has recognized in their by-laws the intermodal container as an item of equipment subject to equipment interchange operations. Also, the Universal Carloading and Distributing Company, Inc. has established a "Thrutainer Service". Under this plan, Universal Carloading

^{1/} At the 1st Inter-American Port Seminar in Bogota, Colombia held in March 1968, Mr. Thomas T. Soulas stated that over 75 percent of the intermodal containers in the Western Hemisphere in early 1968 belong to five ocean carriers-Sea-Land, Seatrain, Moore-McCormack, Alaska SS Co. and Grace Lines - all captive systems.

drayage vehicles make pickups at plants in Illinois, Indiana, Iowa, Michigan, Wisconsin and Ohio for delivery to Chicago for consolidation into Universal's own intermodal containers. Thrutainer shipments move to Europe under a guaranteed through rate. Because of its partners in the United Kingdom and the Continent, Universal Carloading, as a non-vessel-owning common carrier (NVOCC), offers shippers one carrier surveillance and normal common carrier liability on both sides of the Atlantic. 1/

The U.S. Department of Transportation has also recognized the need to promote pooling and interchange of intermodal containers. In August 1969, the Department issued a Request for Proposal 2/ for a study of all elements that would affect the interchange and pooling of intermodal containers in operations conducted by rail, motor and ocean carriers, freight forwarders and others engaged in export/import traffic of the United States. Among other things, the study would consider:

1. The ability to meet shipper requirements
2. The degree of container utilization
3. Movement in non-revenue service
4. Special implications arising from foreign ownership
5. Anti-trust and regulatory constraints
6. Financing requirements.

Based on the analysis of these study elements, an outline was required of the intermodal container pool arrangements considered most feasible with special consideration given to the following factors:

1. Area coordination of containers available

1/ Via Port of New York magazine, July 1969

2/ U.S. Dept. of Transportation RFP, DOT-OS-A9-116

2. Availability of various types and sizes of containers
3. Method of defraying costs of container pool management
4. Mechanics of compensating container fleet owners
5. Liability problems
6. Statistics to be produced and maintained.

Thus, at the present time, there is little industry-wide overall management in the field of commercial containerization. Container fleets are individually operated and controlled, and generally are concentrated in tidewater areas on developed trade routes. Pooling and interchange systems to provide more efficient and economic use of container fleets are in their early stages but do not yet affect most containers owned by the large shipping lines.

OPERATING SYSTEMS

General

Intermodal containers used during the Vietnam era were operated primarily under the following systems:

1. In a captive system under a point-to-point contract such as the Sea-Land operation.
2. Within the established commercial trade routes using ocean carrier-owned transport and container equipment and operating under established shipping agreements with the DOD.

As stated previously, during the Vietnam era, these containers were used basically within the breakbulk cargo distribution environment. However, as the use of containers increased, both users and managers recognized problems in operating areas that precluded their

realizing the benefits afforded by containerized cargo distribution. These are discussed under the following topic headings:

1. Offer, acceptance, release and booking
2. Cargo consolidation and priority implications
3. Documentation.

Offer, Acceptance, Release and Booking

Current procedures^{1/} for the offering of cargo for shipment and ship booking are breakbulk oriented. The introduction of containerized cargo movement has resulted in a number of problems which reflect requirements for modifications to existing procedures. The general practice of forecasting cargo shipments, and the ultimate cargo booking meetings held between transportation management agencies and carrier representatives within DOD (MSTS and MAC) dealing with breakbulk shipments do not provide the precision implied in the matching of specific numbers of containers with named carrier ship departures and arrivals.

In addition, the introduction of the intermodal container has created a new dimension in the cargo offering procedures, namely, how a shipper proceeds to obtain a container when he has elected to use this means of cargo movement. Under the present procedures, the acquisition of a container by the shipper is accomplished concurrently with the cargo offering process. (No military-owned intermodal containers were used during the Vietnam era; thus the existing procedures are oriented toward commercial containers only.)

^{1/} DOD Regulation 4500.32 R, Military Standard Transportation and Movement Procedures (MILSTAMP).

Offering Procedures

The procedures^{1/} used to offer containerized cargo shipments and to acquire containers through Western Area, Military Traffic Management and Terminal Service (WAMTMTS) is shown in Figure 5-3 for point-to-point contract shipping service such as Sea-Land.

The Sea-Land closed loop operation presents few problems. The shippers are designated and few in number, container requirements are programmed in advance and containers are normally available, as required, to meet shipper requirements.

Figure 5-4, however, depicts actions required by the "random" shipper who has a quantity of containerizable cargo to move. As he is not a part of a point-to-point service, and his requirement has not been pre-programmed as part of a closed loop operation, the procedures to obtain the container are more complex and require more time. As shown in the Figure, coordination is required among two Single Traffic Manager organizations (MTMTS AND MSTTS) and the ocean carrier before the shipper is finally notified whether a container is to be made available. The process reflects attempts to apply segmented breakbulk oriented methods to containerized operations which demand and permit streamlined procedures.

Through Bill/Through Movement

After receipt of a container by the shipper, there are two basic methods under which the container can be shipped to oversea consignees:

1/ MTMTS briefing to JLRB, op. cit.

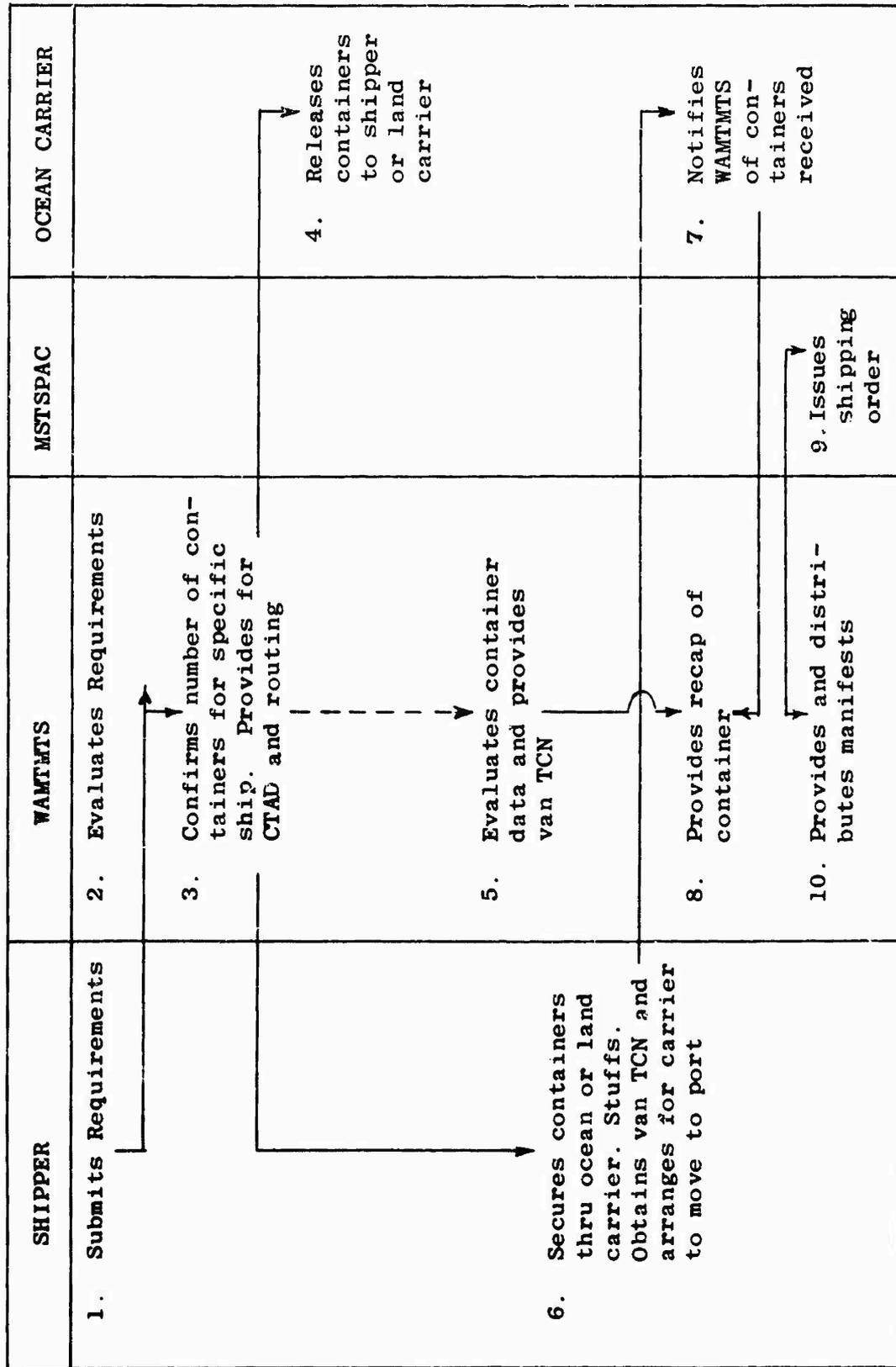


Figure 5-3. Procedure for Point-to-Point Contract Container Service, Sea-Land

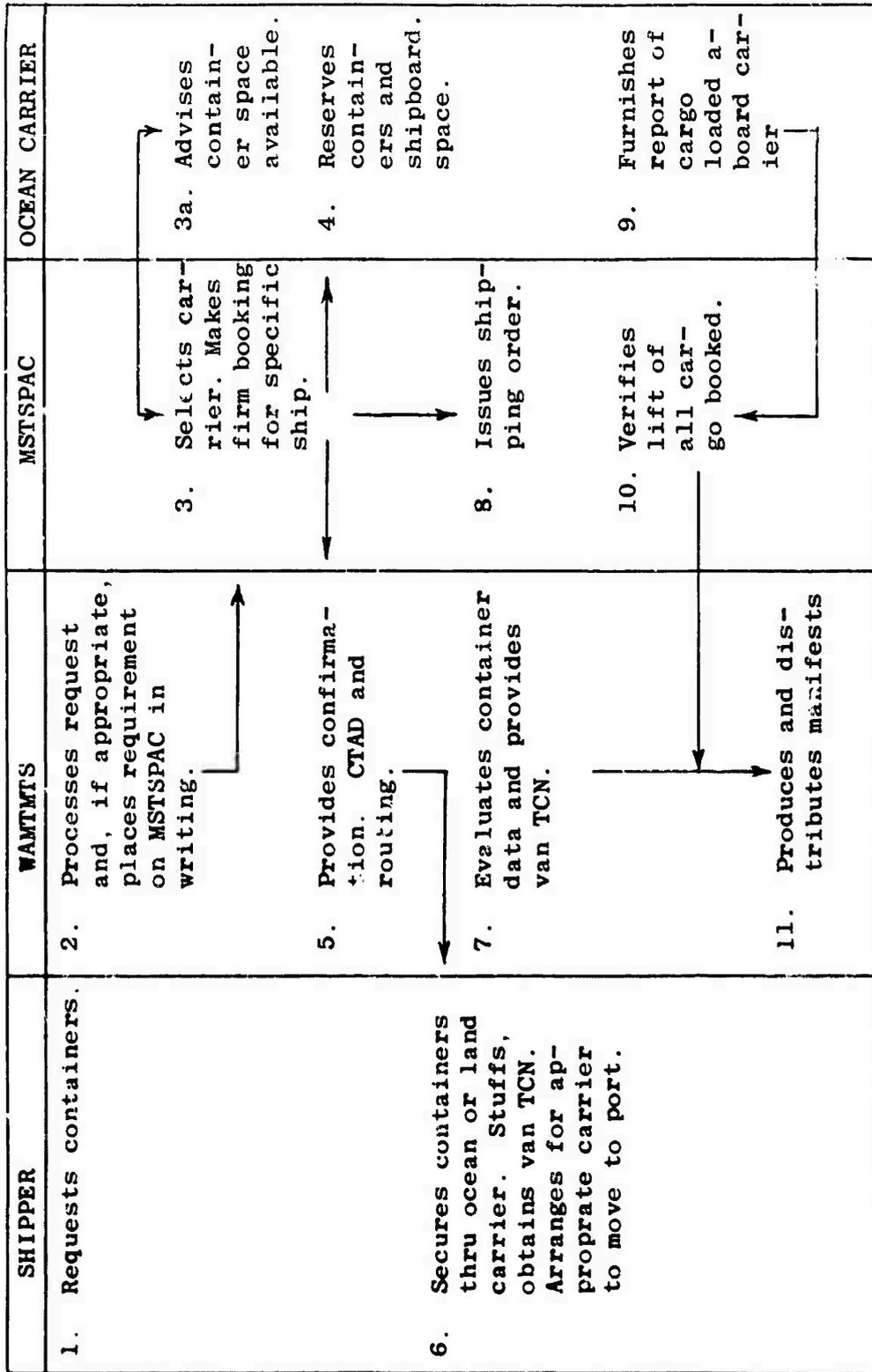


Figure 5-4. Procedure for Using Commercial Container Under Shipping Agreements.

1. Through Government Bill of Lading/Through Intermodal Container Operation (TGBL/TICO)

In the TGBL/TICO method, shipment is made from CONUS point of origin to the oversea destination, with a carrier (or freight forwarder) assuming full responsibility for delivery of the cargo. The TGBL/TICO carrier makes all arrangements with other carriers and terminal operators for the total movement and is paid on one Government Bill of Lading, prepared by the shipper.

Under this method, MTMTS enters into the rate negotiation with the ocean carriers, (since they predominantly are the source for containers) an area which is in conflict with an MSTTS charter prerogative. Consequently, during 1968 with about 12,500 containers being exported monthly, only approximately 2.2 percent were shipped via TGBL/TICO method.

2. Through Container Movement Under Shipping Agreements

Appropriate components of the DOD (MTMTS, MSTTS and oversea commanders) normally make separate arrangements for each modal segment of the total movement. However, for the most part, oversea commanders have elected to have containers move between ocean terminals and inland destinations under the "on-carriage" provisions of MSTTS shipping agreement contracts. In such instances, movement of ocean carrier-owned or leased containers from CONUS inland points to ocean terminals is accomplished by GBL prepared by the shipper. Ocean freight and overseas linehaul "on-carriage" is then covered by the ocean manifest.

Although this method provides through service from the consignor to consignee, it is time-consuming in the arrangement making phase. Because it does not extend the

"on-carriage" feature to CONUS inland moves, it requires documentation through each segment. Here we have the same problem in reverse as discussed above under the TGBL/TICO, i.e., MSTS enters into rate negotiations with ocean carriers for inland container movements overseas which, under the present charter arrangement, is the responsibility of MTMTS.

ASD (I&L) attempted to correct these charter conflict problems through modification of operating procedures. Three directives were issued to the Departments of Army and Navy^{1/} which attempted to streamline existing procedures by authorizing MTMTS to deal directly with the ocean carriers for obtaining intermodal containers and container lift services. (MSTS objected to this procedure because it infringed upon their responsibilities and operations as the DOD procuring agency for commercial ocean transportation services.)

Although this did not fully resolve the problem areas, the interim procedures shown in Figures 5-3 and 5-4 have been effected which enabled cargo offering and release to operate in through container movement.

Cargo Consolidation and Priority Implications

The optimum benefit of containerization is realized when containers are stuffed at the point of origin of the shipment for throughput delivery to the consignee or at the first point when there is sufficient cargo for through movement as a unit load. Containers can be stuffed at the cargo source when adequate quantities are generated for a single consignee or breakbulk point. However, there

^{1/} Memoranda to Army, Navy, Air Force and DSA, "Modification of Procedures for Transportation of Overseas Cargo", dated 18 June 1963, 15 October 1968 and to Army & Navy, 18 December 1968.

are operating reasons why this cannot always be accomplished.

First, containers are not always made available to inland cargo sources due to a lack of two-way revenue cargo (i.e., the cost of moving the "empty" to the consignor exceeds the cost of breakbulk movement to a consolidation point). Second, Movement Priority frequently precludes holding cargo until there is a full container load.

Third, during the Vietnam era, intermodal containers were in short supply and were primarily used in captive trade routes of the ocean carriers. MTMTS, stated that the demand for containers by DOD component shippers during the Vietnam era was greater than the container carrier industry could provide. 1/

Tidewater Oriented Container Stuffing

As intermodal container utilization increases, their availability at more inland shipping points in CONUS can be expected. However, the intermodal container operations in support of Vietnam were basically tidewater oriented. By September 1969, MTMTS records showed that 81 percent 2/ of the total export containers were stuffed at CONUS tidewater areas.

UMMIPS and Container Consolidation

Although the general scarcity of intermodal containers was a major cause for deterring container penetration from CONUS tidewater

1/ MTMTS Containerization Briefing to JLRB, op. cit.

2/ MTMTS RCS DD I&L(Q) 964 Report, "Logistics Performance Measurement and Evaluation System" (Report for 1st Quarter, FY 1970).

to inland areas, a significant factor involved has been the DOD Movement Priority System prescribed in DOD Instruction 4410.6. 1/

UMMIPS was established in recognition of the principle under which the current DOD cargo distribution system is managed, i.e., transportation mode segmentation. Thus, separate segments of the cargo distribution system (military supply sources, transportation) are allocated prescribed time standards within which to accomplish their part of the throughput cargo movement. This system, while making allowances for some consolidation, makes no provisions for system-wide management tradeoffs through the use of more time at a particular segment of the system in order to effect delivery in the shortest time.

Clearly, the intent of UMMIPS is that of "keeping the cargo moving". However, there is no way in which a given node can determine whether it is in the interest of expedited delivery to hold a shipment for consolidation into a unit load. Since the safest course of action administratively is to act within the UMMIPS time standard, this is usually the course of action elected.

During the Vietnam era, considerable liberties were taken in the assignment of UMMIPS IPDs (Issue Priority Designators), and the short times allowed for the movement cycle placed additional pressure on the depots to ship rather than consolidate.

1/ DOD Instruction 4410.6, "Uniform Materiel Movement and Issue Priority System (UMMIPS)."

Consolidation Points

The logic of containerization implies the earliest consolidation of cargo addressed to a single consignee. However, containerized cargo consolidation points were used only to a limited degree. The Army used New Cumberland Army Depot on the east coast and the Sharpe Army Depot on the west coast for containerized cargo consolidation. By late 1969 the Army had completed plans to establish a consolidation point inland at the Red River Army Depot. Consolidation was also accomplished by the Naval Supply Command and the Marine Corps.

The use of consolidation/distribution centers both in CONUS and overseas to optimize containerized cargo distribution is recognized by various elements of the DOD. For example:

1. The Department of Army containerization policy, now being formulated, stresses the need to establish consolidation/distribution centers in CONUS to serve areas within which significant amounts of container eligible shipments which do not comprise full container loads are generated. This document also envisions these centers receiving full container loads (retrograde) for distribution to consignees.

2. USCINCEUR has stressed the need for planning and organizing consolidation/distribution operations to bridge the gap between the water/air terminals, depots and the retail customers. Before the extensive personnel reduction and relocation in USEUCOM, USAREUR operated a number of consolidation/distribution points with considerable success.
3. MTMTS has conducted flow pattern studies of containerizable cargo for the purpose of determining the need for and location of CONUS container consolidation/distribution centers. They also stated that regional consolidation points for containerizable cargo should be established in CONUS to capture the estimated 45 percent of export cargo which is less-than-release-unit shipments.
4. Under the USAF resupply system, many shipments originate in small quantities at numerous shipping points for delivery to a large number of overseas destinations. Therefore, very few shipping activities generate sufficient volume to effectively utilize a Seavan container for a single consignee in a reasonable period of time. Thus, USAF is exploring the use of "container stuffing points" or consolidation points in CONUS and "unstuffing points" or makebulk points in overseas areas. 1/

1/ Headquarters USAF Study on Containerization, op. cit.

Summary of Container Consolidation

During the Vietnam era it was recognized that throuput delivery of the container from cargo source to consignee would be the most efficient and effective use of the container for cargo distribution. However, currently there were shortcomings that deterred this objective. Significant of these are:

1. UMMIPS time standards which are designed around a vertically segmented, breakbulk oriented transportation mode movement.
2. A shortage of containers which limited their penetration inland.
3. The lack of a throughput management system to plan for inland consolidation/distribution points and to schedule containers between the cargo sources and ocean shipping.

Documentation

Although the container does fit within the current DOD documentation system, the system is basically breakbulk oriented. Containerized movement offers an opportunity for a thorough examination to solve some basic problems in documentation. The principal difficulty with the current documentation derives from the fact that supply documentation under MILSTRIP, dealing with supply requisition and issue operations, is Federal Stock Number (FSN) oriented whereas cargo distribution documentation under MILSTAMP, dealing with transportation, is transportation unit oriented.

Severe problems have been experienced. MTMTS reported in a briefing in September 1969 1/ that of 101,224 shipments processed in the CONUS water terminals for export during the month of June 1969, only 74 percent were received with TCMDs. Additionally, when those with errors were considered, only 60 percent of the shipments were received with usable TCMDs. This reflects slow progress in resolving documentation problems when compared with the finding of a 1967 Air Force study 2/ on CONUS intransit control of air cargo. The Air Force found that the aerial ports were receiving only 60 percent of the advance TCMDs on the total shipments received. Only 50 percent of the TCMDs received were usable because cards either were incorrect, incomplete, or were received after the shipment arrived.

Documentation Theory vs Actual Practice

MTMTS 1/ and CINCPACFLT 3/ briefings to the JLRB emphasized the problems associated with the documentation of shipments to RVN and identified the problems concerning containerized cargo shipments.

1/ MTMTS Briefing to the JLRB, op. cit.

2/ Air Logistics Studies-1970's, Annex A, Intransit Control, May 1967, Hq., USAF

3/ CINCPACFLT Briefing to the JLRB, 20 September 1969.

There is no disagreement that, in theory, MILSTRIP will cross-reference to MILSTAMP manifest documentation. Since the theory was sound, why were there problems that prevented the consignee from obtaining the critical information he needed to identify and unload the urgently required materiel? The main reasons have been identified as:

1. Late receipt of ocean manifests
2. Lack of advance information on shipments
3. Improperly prepared manifests
4. Lack of identification of split shipments
5. Receipt of unmanifested containers
6. Containers with cargo for multiple consignees
7. Incomplete markings
8. Improper construction of prime TCN
9. Trailer number missing from TCMD
10. Lack of ability to translate data into useable information.

Two basic causes for these deficiencies were identified. First, there was a high rate of personnel turnover so that those responsible for accomplishing the documentation either disregarded the instructions or were inadequately trained. Second, automatic data processing equipment (ADPE) was needed in RVN and was not always available.

Efforts to Reduce Paperwork In Commercial Container Operations

Documentation problems have plagued commercial operators in much the same way as the military. Their problems were the more severe because of differences and duplication in the node-by-node documentation practices of breakbulk operations. At the request of the National Committee on International Trade Documentation, the Department of Transportation and the San Francisco Marine Exchange accepted

a one-page letter-size form proposed for use by U.S. sea, air, rail and truck carriers and shippers engaged in overseas trade. Use of the proposed form would permit one-time preparation of a document which would serve as a bill of lading. It would also satisfy several additional paperwork requirements of carriers, shippers, forwarders, banks and others dealing with export/import shipments. 1/

It was estimated by the National Committee on International Trade Documentation and the U.S. Department of Transportation in July 1969 that this proposed form, if adopted, would eliminate as many as 12 documents on a typical through intermodal shipment. 2/ Their study on the requirements for improved documentation showed that present practices cost an average of \$163 per shipment, a total of \$5 billion per year, or 10 percent of the value of the shipments.

ADPE and Container Documentation

The response by USEUCOM 3/ and PACOM 4/ relating to documentation and containerization posed by J-4, JCS in March 1969 indicated the following:

1. The current system needed little refinement to meet the needs of an expanded containerized distribution system in the military. Ideally, a punch card

1/ Container News, January 1969, editorial

2/ Press release from National Committee on International Trade Documentation, 31 July 1969.

3/ USCINCEUR Reply to J-4, JCS, op. cit.

4/ UICINCPAC Reply to J-4, JCS, op. cit.

could be made out for each shipment and should accompany it to the destination. At interim stops, successive copies of the item card would be pulled and used to point out whatever documentation was required. An improvement would involve the use of a card which could be sensed as it moved past a point and a print-out furnished of necessary documentation. Presently, it would help to get the manifest in advance and to have containers stuffed for delivery to final destination with consolidations kept to a reasonable minimum. 1/

2. A need exists for a sophisticated container documentation system to permit pinpointing container location in the pipeline and container cargo content at any time. Documentation must go to the "supply manifest concept". This requires that the TCN and the requisition numbers must be married. 2/ Ultimate goal will be to be able to pinpoint the location of each item or shipment. A need exists for a stock control record of what is in the pipeline, particularly for high value and critical items. 3/
3. In the MTMTS Briefing 4/ it was stated that the long range solution to overseas documentation problems appeared to rest with deployable ADP equipment and associated communications. It was considered that STRATCOM had developed the capability to deploy high capacity communications terminals to overseas areas. However, mobile equipment

1/ USCINCEUR Reply to J-4, JCS, op. cit.

2/ For further analysis of this subject area see APJ Report 589-2, "USAMC Milvan Pilot Operation Evaluation System", April 1969.

3/ CINCPAC Reply to J-4, JCS, op. cit.

4/ MTMTS Briefing to JLRB, op. cit.

for ocean terminals is needed to solve, in a future military operation, the documentation problems which had to be solved in the RVN operation by emergency improvisations.

Documentation Summary

Some of the more significant problems associated with documentation that impinge upon containerized cargo operations are identified as the need to:

1. Relate the detailed supply documentation provided for in MILSTRIP to the common identifier in the transportation manifest. (The Transportation Control Number (TCN) provided for under MILSTAMP.)
2. Improve intransit cargo visibility and to enhance intransit materiel accounting (inventory in motion).
3. Facilitate intransit materiel tracing and diversions.
4. Simplify and facilitate the material receipt processes by oversea consignees to rapidly move these materials into asset records and controls.
5. Reduce the volume of paperwork at all nodes of the distribution system.
6. Improve early in-theater availability of CONUS compatible ADP systems.

Thus, from the foregoing, it would appear that Vietnam, like all previous military operations, has provided a number of lessons indicating specific areas where cargo documentation must be improved. The current documentation systems would need very little refinement for container operations. However, the need for an ADP capability at all terminals and intransit points is considered to be a minimum essential requirement for proper control, enroute diversions and the necessary traffic management actions associated with movement control.

The most critical need in this area is an ability to make container manifests available to the intransit points and consignees well in advance of delivery.

As stated earlier, the "box" can live within the current breakbulk oriented cargo distribution documentation system, but it has given us a catalyst around which more effective and imaginative documentation methods can be developed. These can be summarized as follows:

1. Accept the fact that no future military operation should be undertaken without a fully operational ADP system in the overseas area which is compatible in all regards with the CONUS ADP systems.
2. Develop a method of providing container content listings (manifests) to consignees via electronic means considerably in advance of arrival of the container. The common reference number should always be the container serial number--not voyage numbers or TCNs.
3. Improve the cross-reference storage and retrieval processes of critical nodes in the system between the container cargo detail listings (manifests), the TCN, the voyage numbers and the container serial number.
4. Apply the very latest state-of-the-art features in container documentation, using cards keyed to detailed listings and the use of sensing devices to permit selective detailed hard copy print-out production only by nodes in need of such detailed data, and for simplicity of cargo location.

ORGANIZATION AND MISSIONS

General

The transportation and physical distribution organization, missions and functional alignment within the Defense establishment are outlined in JLRB Chapter 2, Transportation Policies, Organization and Missions, and Chapter 5, Transportation Movement Control Visibility within the Transportation System. These elements will be assessed herein only as they bear on the containerized cargo movements operations. Because of the throughput feature of the intermodal container, considerable impact has been felt within the specialized fields of the commercial transportation industry and its related Federal Government agencies. This, in some respects, is felt also within the DOD.

As can be expected, the advent of the intermodal container, and its impact on operating and management structures, is typical in the evolution of hardware technology and the institutional acceptance thereof. The latter has always followed the former. Because of its heavy reliance on commercial industry for its cargo distribution, DOD and its component elements have tended to orient transportation and the cargo distribution functions along similar lines. Thus, there is an inclination to think in terms of specialized transportation modes rather than as a fully integrated throughput system.

Management and Control of Containerization

The question most often raised within industry as well as the military establishment is, how can the introduction of a simple "box" into the cargo distribution systems raise such fundamental issues as the possible need for changes in the structures and organization in the physical distribution industry and possible realignment of roles and missions within DOD and its

component commands and agencies? The most obvious answer is that the "box" does not care, but its arrival on the distribution scene resulted in very large investments in equipment and skills that are remunerative only when all the gains implicit in a through system are actually realized. The introduction of the container has dramatically focused on the need to reorient current organizational structures into a total systems visibility, so that gains in one area are not frustrated by losses in another.

It should be noted that our discussion relates to common user operations, in which cargo moves across the total logistic system. It is recognized that there are specialized applications for containers. These applications most often arise when containers are used for prepositioning of contingency readiness stocks, as consolidation devices for local moves, and as contingency rapid deployment facilities. Such requirements may be met by block allocation of containers in a manner similar to the block allocation of Conexs to the overseas commanders. In these instances, mission criticality, as well as sound management require the same attention to management and control by the user as described for common user services.

Comments on Management

A review of recent observations and comments by key elements of the DOD transportation and cargo distribution system reflects a possible need for establishing a focal point for the coordination of containerization within the DOD. Some of the more pertinent of these have been summarized below. 1/

1/ Letter on Containerization sent to CINC by J-4. JCS, 4 March 1969, CINCSTRIKE Reply dated 7 August 1969. USCINCEUR Reply dated 10 September 1969 and USCINCPAC Reply dated 7 April 1969.

1. The DOD is represented on the U.S. Department of Transportation Task Force on coordination of U.S. container programs by a member of OASD (I&L) Transportation and Warehousing Policy. However, developments indicate that OSD looks upon containerization as basically associated with the transportation field and that impacts on distribution systems are not of prime concern at this time. Therefore, OSD tends to lean towards maximum use of commercial containers.
2. Some expressed a concern for the lack of centralized (or at least coordinated) direction within the Defense establishment as well as in industry. There was general acceptance of a need of an overview evaluation and review of the existing organization for transportation and distribution as a basis for practical realignment of containerization responsibilities. In this connection it was suggested that DOD avoid creation of a complex system hampered by old administrative and organization concepts.
3. USEUCOM stressed a recent experience they had with MSTS and MTMTS which highlights a possible need for a better integrated DOD transportation and distribution system. This concerned steps taken by MSTS and MTMTS each contracting separately for transoceanic and theater land leg movement of container traffic to Europe. USEUCOM stated that this could have, in effect, superimposed two outside traffic management agencies on the existing theater traffic management system. By direct contact with the single manager agencies, USEUCOM was able to work out operating agreements satisfactory to all concerned. However, it was emphasized that ad hoc agreements on operating procedures, must recognize that any determination of the in-theater movement and consignee acceptance priority, as well as a need for inland diversion, must be coordinated and accomplished by, or in concert with, the theater traffic manager.

System Management Considerations
by the DOD and Industry

The need for system wide visibility in containerization was further pointed out by the ASD (I&L), Supply and Services in his attempt in 1967 to establish a Program Coordinator for Containerized Shipments. Although not implemented, it addressed the need for a single point of contact, or staff coordination. Certainly, recent developments, both in industry and the Government, present numerous examples where a need for a systemwide overview of containerized cargo operations has been recognized. Typical of these are the two examples cited below:

1. Department of Transportation, U.S. Government^{1/}

The Department of Transportation (DOT) has established a task force under the Transportation Facilitation Committee composed of representatives from Commerce, Defense, Labor and Agriculture. Five work groups have been established covering surface intermodal systems, air intermodal systems, intermodal statutory and tariff provisions, intermodal cargo inspection procedures and intermodal statistics and codes.

2. U.S. Transportation Industry^{2/}

The Steamship Operators Intermodal Committee was formed for the purpose of establishing close collaboration between ocean and inland carriers. Areas of common interest being stressed are: in land movement of empty and loaded containers, charges and practices of overland carriers, requirements for interchange of container equipment, consolidation and distribution of cargo in the interior, inland and throughput documentation,

1/ Defense Transportation magazine, May-June 1968.

2/ Container News magazine, October 1969.

government regulation of inland movements, insurance and liability for containers and related equipment, expedition of throughput movement and forming of joint throughput intermodal rates.

The OASD (I&L), Transportation and Warehousing Policy, represents the DOD on the DOT Transportation Facilitation Committee. In addition, the Special Assistant for Strategic Movement (SASM), OJCS provides a single point of staff responsibility concerning containerization in support of rapid deployment of units and related strategic mobility matters.

Summary of Critical Systems Interfaces

The Vietnam experience highlights the critical interface problems that have always existed between the shipper, the movements control agencies and the transportation operating agencies in the movement of cargo to and from theaters of operation. Breakbulk oriented organizations and procedures with the excessive documentation make these interfaces very sensitive. Some of the more pertinent of these to containerization are identified below:

1. Lack of policy and doctrinal guidance regarding the use of intermodal containers in support of contingency operations created problems for those commanders having responsibilities for readying rapid deployment forces. This was especially critical to CINCSTRIKE.1/
2. The mission and functional assignments within ocean terminals and depots made no provisions for intermodal container consolidation distribution functions. Each tended to reject this function as being neither an ocean terminal nor a depot function.2/

1/ CINCSTRIKE reply to J-4, JCS, op.cit.

2/ USCINCEUR reply to J-4, JCS op.cit.

3. Current cargo offer, acceptance, release and booking procedures were breakbulk oriented and did not readily lend themselves to providing a shipper with intermodal containers when and where needed.
4. Charters of MSTS and MTMTS conflicted as regards moving containers in the DOD cargo distribution system under the TGBL/TICO container movement concepts.
5. Methods of consolidating less than carload or truckload export shipments were developed under the breakbulk cargo movement concept and did not lend themselves to optimum use of intermodal containers.
6. The UMMIPS tended to discourage use of containers where cargo volume did not permit daily movement of full containers and powerfully demonstrated the need for basing the decision on total throughput delivery time rather than on individual segment performance time.

SUMMARY

In summary there is little published policy specifically related to containerization at any level in DOD. However, a considerable amount of effort and thought is being devoted to the subject of containerization and its attendant problems. Major areas of concern and thus probable areas for policy promulgation appear to be:

1. The adequacy of a highly containerized U.S. Flag fleet to meet military support requirements.
2. The appropriate uses of containers in the military systems - both in distribution and other logistic applications.
3. Ownership and control requirements for containers in the military environment.

4. System-wide approach to container cargo movements from the shipper to the user - transportation planning for throughput delivery.
5. Military container standardization requirements.
6. The reciprocal relationships and impact of containerization with DOD organizational structures and functional assignments.

CHAPTER 6

**MILITARY OWNERSHIP
AND CONTROL CONSIDERATIONS**

CHAPTER 6

MILITARY OWNERSHIP AND CONTROL CONSIDERATIONS

GENERAL

The major increase in logistic effectiveness through the use of containers involves the timely availability of the proper number and mix of containers, containerships, and ancillary equipment. Additionally, roll-on/roll-off ships are required to handle wheeled and tracked vehicles and the small amount of other cargo which cannot efficiently be moved in containers.

An obvious question is whether the government should own these assets and have them in Defense Department stocks, whether they should lease them from commercial owners for exclusive military use through emergency requisitioning powers or voluntary agreements, whether these assets should be provided by contract with commercial operators, or whether there should be a mix of two or all of these options. These questions are inseparable from the matter of the readiness posture of defense forces for a contingency.

The readiness posture of the military forces is dictated by national policy and involves considerable differences in degree of readiness for operations of differing sizes. A review of the current policy and its application in the Vietnam conflict is helpful in assessing the necessity for military ownership and control of transportation equipment, including containers, to meet military readiness requirements.

TRANSPORTATION REQUISITIONING AUTHORITY IN
TIME OF WAR OR NATIONAL EMERGENCY

Because of the extensive impact on future lift capability caused by the intermodal container, a brief review is required of current authorities under which the DOD may requisition commercial surface and airlifts in times of emergency. The intent here is to assess these matters from two points of view, namely:

1. To what extent must the DOD acquire its own transportation capability, including an intermodal container fleet because of its inability to acquire, in times of emergency, containers in use by commercial operators?
2. To what extent are current laws and authorities under which commercial surface and airlifts are requisitioned by the Government in times of declared national emergencies applicable in the context of large-scale container movements.

During the Vietnam era, most commercial intermodal container fleets were owned by ocean carriers. However, trends would indicate that within the next decade, an ever increasing number will be owned by container pool operators and by non-vessel-owner common carriers (NVOCC). This trend will probably also extend to air carriers when suitable air/surface intermodal containers are in use.

The current provisions under which lift capability can be requisitioned by the DOD in time of a declared national emergency have been covered in Chapters 2 and 3 of the Transportation Monograph. Following, is a brief review of the major provisions.

Surface Transportation

1. Pertinent parts of the Merchant Marine Act of 1936 - 46 U.S.C. 1101 - are covered below. 1/
 - a. "U.S. Merchant fleet shall be capable of serving as a naval and military auxiliary in time of war or national emergency."
 - b. Section 501 provides the basis for the "national defense features" in merchant ships and authorizes construction-differential subsidies to "make ships suitable for use by the U.S. for national defense or military purposes in time of war or national emergency."
 - c. Section 902 authorizes "requisitioning or purchase of any U.S.-owned merchant vessel whenever the President shall proclaim that the security of the national defense makes it advisable or during any national emergency declared by proclamation of the President."
2. Early in the Vietnam era, DOD Deputy General Counsel advised J-4, JCS that the declaration of national emergency by President Truman on 16 December 1950 was sufficient to bring into effect the power and authority to acquire ships under Section 902. 2/
3. DOD/Commerce Agreement - 1954 Wilson/Weeks Agreement - (DOD Instruction 5030.3, 20 October 1954, subject: Memorandum of Agreement between DOD and the Department of Commerce Dealing with the Utilization, Transportation

1/ Chapter 2, Transportation Monograph

2/ MSTS Presentation for the JLRB, 19 June 1969

for and Allocation of Merchant Ships) authorizes MSTS nucleus fleet but restricts the nucleus fleet under conditions short of full mobilization to those ships, tankers, and specialized ships needed to:

- a. Carry out current logistic needs which cannot be met by commercial interests.
- b. Provide immediate capability in an emergency.
- c. Provide adequate base for necessary expansion to meet mobilization requirements.

The agreement also:

- a. Stipulates maximum use of commercial shipping.
 - b. Provides that procurement of ocean shipping beyond MSTS nucleus fleet be taken in the following order:
 - (1) Maximum use of U.S. Flag berth space - i.e., cargo space aboard regularly scheduled vessels.
 - (2) Time charter of private owned U.S. Flag ships voluntarily made with industry.
 - (3) Shipping provided by National Shipping Authority (MARAD) under General Agency Agreement i.e., Government-owned ships operated for MSTS by a MARAD-approved commercial ocean shipping company.
 - (4) Foreign flag shipping. 1/
4. The Transportation Act of 1940 - 54 Stat. 898- under the Interstate Commerce Act, covers the requisitioning and

1/ Chapter 2, Transportation Monograph

regulating of the following domestic transportation in time of declared national emergency:

Freight forwarders
Railroads
Express companies
Petroleum pipelines
Motor carriers
Domestic water carriers.

5. The RESPOND program was initiated by the DOD to induce (through a peacetime cargo allocation), commercial ocean operators to commit themselves to make ships available to the DOD in times of emergencies. This program was partially implemented with the FY 70 competitive commercial ocean transportation services procurement program. The partial implementation requested steamship operators to agree to commit specific ships to support military emergencies. As of 19 June 1969, cargo allocation and the rate aspects of the program were still under study and retarding its full implementation.^{1/}

Air Transportation

1. The Federal Aviation Act of 1958 - 49 U.S.C. 1302 - states that "the Board (CAB) shall consider the following, among other things, as being in the public interest and in accordance with the public convenience and necessity."^{2/}

"Sound development of an air-transportation system properly adapted to the needs of the foreign and domestic commerce of the U.S., of the Postal Service, and of the national defense."

^{1/} MSTB Presentation for the JLRB, 19 June 1969

^{2/} Chapter 3, Transportation Monograph

2. The DOD-Commerce Agreement states:
"Foreign-flag air carriers will not be used for DOD traffic except when (1) U.S. Flag air carriers are not available or capable of satisfying the transportation requirement or (2) foreign-flag carrier will accept payment in excess or near-excess U.S.-owned foreign currencies which U.S.-flag carriers will not accept, and the use of such carriers will not result in increased costs to the DOD."1/
3. DOD Directive 3005.7, 7 May 1968, subject: Emergency Requirements, Allocations, Priorities and Permits for DOD use of Domestic Civil Transportation covers:
 - a. Use of CONUS domestic air transportation in an emergency except for Civil Reserve Air Fleet (CRAF) and certain other organizations.
 - b. That DOD transportation plans and operations for national emergencies will conform to national policies and guidance.1/
4. CAB is responsible for programs establishing the War Air Service Program (WASP) to provide for maintenance of essential civil air routes and services, and to provide for the distribution and redistribution of air carrier aircraft among the civil air carriers after withdrawal of aircraft allocated to the CRAF. The Secretary of Defense has been authorized to administer the WASP Air Priority System (AR 55-355).2/

1/ Ibid.

2/ Chapter 2, Transportation Monograph

5. Civil Reserve Air Fleet

- a. The Civil Reserve Air Fleet (CRAF) program is a plan for meeting the defense requirements for airlift during a formally declared national emergency. This plan was initiated by joint agreement between Defense and Commerce on 15 December 1951.
- b. The agreement was updated in a Memorandum of Understanding By and Between the Secretary of Defense and the Secretary of Commerce, dated 8 August 1963. The basis for the CRAF as it exists today is an Executive Order issued in 1962 (E.O. 10999.) 1/
- c. Activation of the CRAF is provided on an incremental basis to meet varying defense emergency needs. Four stages are recognized, beginning with the normal day-to-day civil airlift augmentation obtained under MAC fixed contracts. Each of the four stages is shown below. 2/

Stages	Description	Authority
Peacetime Operations	Support of deployed forces	Executive Director Single Manager Operating Agency for Airlift Services
Airlift Emergency Stage I	Support of counterinsurgency activities and localized emergencies	Secretary of Defense
Airlift Emergency Stage II	Support of limited wars	President of the United States
Airlift Emergency Stage III Activation of CRAF	Airlift services during major military engagements involving U.S. Forces (limited or general war)	Declared National Emergency-Secretary of Defense

1/ USAF JAG Law Review - May-June 1968

2/ Memorandum of Understanding, DOD/Commerce, 8 August 1963.

- d. The operating part of CRAF is the selection of specific equipment owned by civil air carriers considered suitable to DOD requirements. Civil carriers selected for CRAF agree to maintain the equipment in the required configuration and to the delivery of this equipment to DOD control under the terms of the agreement. In return, these carriers are given preferential treatment over non-CRAF air carriers in the allocation of contracts by MAC for civil augmentation airlift. Each contract covering such services contains the detailed obligations of the CRAF program.
- e. As of 30 September 1969, the following aircraft were available under the CRAF Programs. 1/

Aircraft Type	Domestic (Cargo)
B-727C/QC	13
DC-9-30F	7
L-100/382	4
L-188C	21
AW-650	8
C-46	1
Domestic Total (Cargo)	54
	Alaskan (Cargo)
B-737-200C	1
L-382	1
F-27	5
C-46	4
DC-3	2
Alaskan Total (Cargo)	13
	Short Range International
B-727C/QC	15
CL-44	2
Short Range International Total	17

1/ MAC Hq. Form 0-312 - Monthly Civil Resume, Air Fleet Allocation Summary

Aircraft Type	Long Range International (Passengers)
B707-321	5
B707-321B	59
B707-331B	38
B707-351B	10
B707-300C	20
DC-8-61	37
DC-8-62	4
DC-8-63	2
Long Range International Total (Passengers)	175

	Long Range International (Cargo)
B707-300C	111
DC-8-50F	30
DC-8-61F	10
DC-8-63F	40
Long Range International Total (Cargo)	191

GRAND TOTAL	450
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From the foregoing, it would appear that the use of emergency powers could have produced adequate strategic transportation to support the Vietnam operations.

However, as noted earlier in this report, emergency powers were not exercised for support of Vietnam. Thus, notwithstanding the above laws and administrative authorizations, the DOD did not acquire lift resources through the process of requisitioning. However, through the execution of the highest commercial augmentation procurement program in MAC history (\$394 plus million), strategic airlift was generally current with requirements in 1966.

The matching sealift requirements, however, presented problems. The RESPOND program was still in process of implementation in FY 70 and the directly subsidized ocean

operators, who received Government funds to build and operate ships, voluntarily provided only about 20 percent of the augmented sealift capacity required. 1/

Consequently, it was necessary on occasions, to use foreign flag vessels to meet total sealift requirements on a timely basis.

Containers

None of the above regulations and agreements relate to the requisitioning of containers for transoceanic shipment. While it is possible that the requisitioning of containerships might carry with it some number of associated containers, this possibility is not addressed in the various regulations and agreements discussed above, most of which were enacted prior to large scale use of intermodal containers.

During the Vietnam era, container support was obtained by contract with a carrier who provided both the containers and containerships. This capability accounted for only a small percentage of total containerizable cargo movements and was not available until 1967. Analysis of proposals and contract negotiations produced a lead time of more than a year between the Request for Proposal and the initiation of service.

This chapter presents an analysis of the physical requirements to meet contingencies in terms of the numbers and types of equipment necessary to take maximum advantage of the principle of containerization. The major considerations related

1/ Chapter 2, Transportation Monograph

to Defense Department ownership and control of such equipment for a contingency use are also discussed.

Response Time

The numbers and types of equipment items, which the Defense Department must have under its immediate control at the initiation of a contingency action, is a function of the time required to procure additional equipment or services. This lead time has two segments: first, the time necessary to process requests for procurement and to place contracts; secondly, the time necessary for commercial contractors and vendors to react to requirements placed on them. The former can be viewed as, more or less, a fixed period. The latter may be affected by several factors, such as the relationship between the requirements of the military and the total worldwide availability of suitable equipment, (both in numbers and types), the existing commercial commitments of the contractors for use of that equipment, and the location of the equipment when the requirement is established.

There are also certain major items of equipment not commonly available on an immediate basis in commercial channels, and in such cases, options are limited to prior military ownership of such equipment, or a long lead time for its manufacture.

The only actual experience available concerning the lead time required for securing equipment peculiar to containerization is the contract negotiated with Sea-Land Service Incorporated, for the movement of military cargo from CONUS to Vietnam. As noted above, the lead time for this contract was slightly over

one year. However, it is felt that with the experience gained in the operation of this contract, and with proper planning, this time could be considerably lessened in any future similar situation. Therefore, six months from the time when the need becomes known, until the equipment is actually in the hands of, or in use by the military, is considered a reasonable lead time. To the extent that actual performance falls short or exceeds this time span, there will be a corresponding effect on resources required.

TYPES OF EQUIPMENT REQUIRED

The types of equipment discussed in this chapter are the types described in previous chapters of this report. Container requirements, in general, are stated in terms of 20' long by 8' wide by 8' high container equivalents. For very dense cargo, and for some types of ammunition, there will be a requirement for 4' high gondola containers.

Containerships required for contingency support are considered to be self-sustaining.^{1/} It is assumed that until deep-draft piers capable of supporting non-self-sustaining ships are in place, port terminals will have limited or no deep-draft berth facilities. This limitation will require extensive use of over-the-shore and beach landing operations, and thus require the use of self-sustaining containerships for container unloading.

The number of ships required assumes a carrying capacity of 850 20' equivalent containers, based on current containership construction programs.

^{1/} It should be noted that proposals have been made for interface units to handle non-self-sustaining ships (see Page 7-16). However, these will require development and tend to make operations more vulnerable and less flexible.

Roll-on/roll-off ships are also expected to play an important part in support of a contingency operation, particularly for movement of unit equipment and other support vehicles. The requirement for such ships in this analysis are based on a RO/RO ship capability comparable to the existing ADMIRAL WILLIAM M. CALLAGHAN, which has a lift capacity of approximately 15,000 measurement tons.

Deep-draft piers are considered to be of the portable type with ancillary equipment, consisting primarily of reinforced decking, two gantry cranes and two roll-on/roll-off interface modules.

Shallow draft equipment considered in this discussion is comparatively simple in concept. It consists merely of lighters for moving containers from containerships, unloading in the roadstead to a beach or unimproved pier landing location where land-based mobile cranes can remove the containers from the lighters, and place them on chassis on shore. It is recognized that other LOTS concepts, such as the use of LASH vessels, and of the helicopter transfer may well be practicable within the 1970-1980 timeframe. However, it is not considered that their current development and availability make them practicable as operating equipment for this discussion. Similarly, the means for movement of roll-on/roll-off cargo from deep sea RO/RO vessels to shore locations prior to the availability of deep-draft berths, is limited to the use of Beach Discharge Lighters, such as the LT. COL. JOHN U.D. PAGE now in operation. Again, this limitation is established purely as a convenient means of establishing a unit of measurement, and to insure a realistic approach to the problem.

METHOD OF APPROACH

Equipment requirements have been analyzed in terms of support of a two Division strike force and their supporting elements, with an estimated total strength of approximately 60,000 troops. This force is self-contained, with no theater superstructure, but does include Air Force elements and Navy support. No attempt is made to establish a specific force structure nor are tactical factors, such as opposed landings, introduced. The basic purpose of the analysis, which is to establish logistic support requirements, can be better accomplished without these complicating factors.

The analysis is based on conditions related to the Vietnam environment as experienced in the rapid buildup period. Thus, it is assumed that no piers capable of handling non-selfsustaining containerships are available, and that most cargo must be handled over the shore for approximately a 90-day period until deep-draft piers capable of handling containerships are available. It is probable that future contingencies will not exactly parallel the Vietnam situation. However, results related to a known base such as the Vietnam environment can be more readily applied than those obtained from a completely new scenario.

The requirements stated are those necessary to support a force of the size specified for an indefinite period. However, it is expected that commercial support could be obtained by 180 days (as noted above) and that pier installation would be completed in 90 days. Thus, expansion of the forces could take place rapidly after the 180 day period (see "Time Impact" section of Chapter 3).

Finally, it is recognized that most troops will be moved to the deployment area by airlift and that airlift will also play a part in supporting the movement of unit equipment and supplies. The use of large aircraft, such as the C5A, provides a capability both for roll-on/roll-off lift of vehicles and intermodal container movement of other cargo. However, the subject of airlift of intermodal containers is currently under intensive investigation by the Department of Air Force. The results of this investigation have not yet become available. The question of whether airlift intermodal containers will be specially designed to weight and strength criteria, different than containers for surface lift are primary subjects of the investigation. It might be noted that a study by the Douglas Company concluded that the conventional 20 foot container was cost effective overall, and recommended the use of auxiliary restraints to meet g-load requirements.

Thus, it is apparent that modern, logistic support aircraft under procurement by the Air Force (C5A, C-141) can participate in the deployment of contingency forces and their resupply. The total quantity of intermodal containers required for such operations have been established elsewhere in this Chapter. These containers can move by air or by surface lift, and the choice of mode relates to the trade-off among the number of vessels and aircraft available, time and distance constraints and quantities of troops and cargo to be moved, all related to the specific contingency requirements.

Because of the complexity of establishing airlift and air container requirements under the many combinations of sea and airlift available, and the time limitations for this study, it has been assumed that unit

moves and resupply are accomplished by containerships and RO/RO vessels. As it is expected that containers moved in to support the force will not be returned until after the 90-day period for pier installation, (thus permitting their use for storage and other purposes), there will be no turnaround and this assumption will not affect the total number of containers required during the buildup period. Container requirements are, of course, related to cargo requirements, regardless of movement mode. Air support would reduce surface vessel requirements to some degree with the amount of reduction dependent on the airlift capability. Application of cargo capacity and turnaround factors for the two types of lift permit ready conversion.

FACTORS USED

The analysis is based on cargo tonnage required for strike force support which must be moved to the area of operation by each of the various modes. The immediate results are, therefore, expressed in terms of equipment requirements that are related to the time intervals at which cargo tonnage requirements are computed, i.e., monthly. Thus, the initial analysis establishes monthly requirement factors for such items as the number of container loads and the number of containerships and RO/RO ships required to arrive at the landing sites.

To convert these factors into systems wide equipment requirements, certain capability factors for the selected equipment types have been developed which are discussed below.

Surface Lift

Surface cargo characteristics for support of the operation are assumed to be comparable to those of cargo actually moved to Vietnam; consisting of about 67 percent containerizable cargo, 28 percent RO/RO cargo, and 5 percent non-containerizable breakbulk cargo. It is further assumed, as noted in Chapter 2, that this small portion of breakbulk cargo would not be shipped separately in breakbulk ships, but would be loaded on flatbed trailers or similar vehicles, and carried in the RO/RO mode.

The average RO/RO ship has been assumed to have a capacity of approximately 15,000 measurement tons and a speed of 26 knots. Using the 7,200 mile great circle distance from San Francisco to Saigon, results in a steaming time of approximately 277 hours or 11.5 days in each direction. It has been previously established in this Report that such a vessel will require approximately 1.5 days for unloading. Assuming an equal time for loading, produces a minimum round trip time of 26 days. Allowance of a 25 percent factor for slippage, maintenance, downtime, and other delays results in an average of 32.5 days per round trip and an average capacity of 13,845 measurement tons per month. This, therefore, produces a requirement for one RO/RO ship for every 13,845 measurement tons of RO/RO cargo to be moved to the area per month.

The average selfsustaining containership has been estimated to have a capacity of 850 containers (20' equivalents), and a 26 knot speed. It is assumed that with adequate lighterage support, a 24-hour per day operation, and the deferment of container retrograde movement until full

pier capability is established these ships could also be unloaded in 1.5 days. Application of the factors cited above produce a monthly capability per self-sustaining ship to deliver 785 containers per month, containing approximately 16,000 measurement tons of cargo.

Containers

Container requirements have been calculated using the container capacity factors shown in Table 6-1 below, assuming approximately an 80 percent utilization of the total available volume.

Type of Container	Capacity (Measurement Tons)
Dry Cargo Container 8' x 8' x 20'	21
Dense Dry Cargo Container (Gondola) 8' x 4' x 20'	10
Refrigerated Container 8' x 8' x 20'	16.5

Table 6-1. Container Capacity at
80% Utilization

The distribution of containerizable cargo among the various types of containers on a measurement ton basis, has been taken from information previously presented in this Report and is shown in Table 6-2.

Type of Container	Percent of Containerizable Cargo
Dry Cargo Container 8' x 8' x 20'	82.6
Dense Dry Cargo Container (Gondola) 8' x 4' x 20'	11.8
Refrigerated Container 8' x 8' x 20'	5.6

Table 6-2. Distribution of Containerizable Cargo by Type Container

90-DAY CONTINGENCY REQUIREMENTS

Hypothesis

The analysis presented below is based on the assumption noted above. The contingency requirement exists for the transportation and support of a two-Division force, plus supporting troops to the COSCOM level, or approximately 60,000 men. The distance involved is approximately that from CONUS to Vietnam (7200 nautical miles). The movement including the provision of support increments is to be accomplished in approximately 90 days.

Tonnage Considerations

The gross tonnage required for the movement and support of troops, and the mix of that cargo in terms of containerizable, non-containerizable and RO/RO, is based on information developed from Vietnam cargo

statistics and included earlier in this Report. As noted in Chapter 3, actual experience in Vietnam showed a requirement of 89,000 measurement tons of unit move cargo, and 37,000 measurement tons per month of support cargo for each 15,000 troop increment moved into the theater. It was also determined in Chapter 2, that approximately 67 percent of this cargo was containerizable, 28 percent RO/RO and 5 percent non-containerizable. Non-containerizable cargo, when converted to the RO/RO mode, incurs a space usage penalty of approximately 31.25 percent. Application of this factor to the 5 percent non-containerizable cargo results in a 1-1/2 percent increase in total cargo tonnage space requirements. ^{1/} Therefore, 67 percent of the cargo requirements must be met by containers and containerships, and the equivalent of 34-1/2 percent of the cargo requirements must be met by RO/RO equipment and RO/RO ships.

Shipping Requirements

The capacity and time factors related to the selfsustaining and RO/RO ships considered for use have been provided above.

As noted above, for each troop increment of 15,000 men introduced into the theater, it is necessary to provide for the landing of 89,000 measurement tons of unit move cargo, plus the monthly support requirements of 37,000 measurement tons of cargo; thus, the total cargo landed in any one month must equal 89,000 measurement tons times the number of 15,000 men troop increments landed during that month, plus

^{1/} The cargo is assumed to be loaded on flatbed trailers. The lost space under and between trailers results in the trailer load occupying 31.25 percent more volume than would the shipment carried on the deck.

37,000 measurement tons times the number of 15,000 man troop increments landed in that and all previous months. Applying the factors derived above to containerized and RO/RO cargo results in a containerized cargo requirement of 59,630 measurement tons of unit move cargo per 15,000 man troop increments and 24,790 measurement tons per monthly support increment for the same size troop increment. The comparable RO/RO tonnage is 30,705 measurement tons of unit move cargo for each troop increment landed, and 12,765 measurement tons of support cargo for each troop increment each month.

Movement of containerizable cargo required to support a buildup to 60,000 troops in a 90-day period would require ten container-ships of the type mentioned. The monthly capacity in measurement tons of the ten ships, is 850 containers per ship times 21 measurement tons per container, times ten ships, times .923 (the ratio of the 30 days in a month to the 32.5 days turnaround time), or a total capability of 164,756 measurement tons per month. In the first month, this capability can provide for the landing and support of 1.95 troop increments or 29,250 men. In the second month, this capacity can provide the support of the previously landed increments, plus an additional 1.38 troop increments or a total of 49,950 troops. In the third month this capability can provide for the support of the previously landed increments, plus an additional landing of .97 troop increments, which is slightly more than is required to land the total of 60,000 men.

Six RO/RO ships of the type mentioned are required to support the buildup rate. The total RO/RO capacity per month is 15,000 tons times six ships, times .923, a total of 83,070 measurement tons per month. These

ships provide a capability to land 1.91 troop increments in the first month, 1.35 in the second, and .95 in the third; very closely paralleling the containerized schedule described above.

Vessel, Equipment and Facility Requirements

After completion of the buildup, support requirements would decrease to 148,000 measurement tons per month (37,000 tons per troop increment for 4 increments). This reduction would reduce ship requirements by approximately four container-ships and two RO/RO ships, which would be available for support of further expansion, if required, or for other missions.

In addition to the actual fleet of ten containerships and six RO/RO ships, it would be necessary for DOD stocks to contain the necessary auxiliary equipment to provide a rapid unloading capability. The containers would be lifted from the containership by the two gantries of the selfsustaining ship and placed on barges or lighters, which would be then moved to the shore and the containers would be unloaded from the barges onto their chassis by the use of land-based mobile cranes. This is estimated to require, allowing for time lost on the trip to and from shore, either six lighters self-propelled, or six barges and three tugs, each of the lighters or barges would require a capacity to carry at least six containers. The use of larger or smaller barges would affect only the number of barges required. Four large, mobile cranes would be required to provide the capability to unloading the containers from barges and place them on chassis.

The RO/RO ships would be unloaded by the use of Beach Discharge Lighters similar to the existing LT. COL. JOHN U.D. PAGE. However, since it would be necessary to provide for a continuous outflow of vehicles from the RO/RO ship, two such Beach Discharge Lighters would be required.

During this period of contingency landing operations, it would probably be necessary to install a large portable type pier with reinforced decking, gantries, and RO/RO interface units, such as previously has been described in this Report. The decision to build such a pier would have to be made at the outset of the contingency operation, and the decision would depend upon the anticipated duration of the operation and the probability of escalation or acceleration of the operation. The fleet of ships described above, together with the auxiliary equipment mentioned, would have a capability to sustain the force of 60,000 men placed ashore in accordance with the contingency plan. However, it would not have a capability of continuing to increase this force at the same rate and to provide continued support to the increased force.

It should be noted that in this concept, no requirement exists for the use of breakbulk cargo shipping. There are tradeoffs in the detailed requirements depending on the force composition, distances involved, relative use of airlift, and the containerization of certain cargo which normally go in the roll-on/roll-off mode.

1/ MSTS Presentation to JLRB, 19 June 1969.

Container Requirements

Based on the total cargo requirements previously established, the number of containers required to be landed in each month of the six month period can be calculated by type of container. Since the supporting fleet and equipment would be operating at full capacity (approximately 248,000 measurement tons per month), during the first three month buildup period, the number of container landings required in each month would be identical. In the second three months of the period, cargo requirements would decrease somewhat (148,000 measurement tons per month) since no further unit moves are involved, and cargo lift is required only for the troops in the area. As the number of troops being supported (60,000) is constant during this period, the container requirements for each of those three months would also be constant. These requirements are indicated in Table 6-3 below.

Type of Container	Container Landings Per Month	
	1st 3 Months	2nd 3 Months
20' x 8' Dry Cargo	6,480	3,900
20' x 4' Dry Cargo	1,945	1,170
20' x 8' Refrigerated	559	337
TOTAL	8,984	5,407

Table 6-3. Container Landings By Type of Container

It must be assumed that under the condition of LOTS operations, with considerable pressures on landing maximum volume of cargo, and requirements for container use in the area to meet storage and other non-transportation requirements, there will be few, if any, empty containers barged out to containerships in the harbor for retrograde movement. However, as soon as full pier capability is established, assumed to be at the end of the 3rd month, there should be maximum return of waiting empty containers. In Chapter 2 a 75-day turnaround time for containers used in Vietnam in the transportation function was established, which provided for 20 days in Vietnam and 55 days for round trip travel and CONUS handling and loading. Thus, containers which leave Vietnam for CONUS, can be expected to be back in Vietnam in 55 days.

Therefore containers leaving Vietnam at the beginning of the fourth month of the operation in retrograde movement will start to return to the theater at approximately the end of the fifth month. Thus, returns and shipments from the beginning of the fourth month would be on a one for one basis. The net effect of this would be to leave in the area for storage and other non-transportation uses a number of containers equal to the input for the first three months, a quantity more than adequate to satisfy these requirements. Excess containers could be returned on their chassis in RO/RO vessels when a need for them in the area ceased to exist.

The total number of containers required to achieve this closed cycle operation, would thus be, for each type of container, the total number required in the first five months of the operation. These requirements are indicated in Table 6-4.

Type of Container	Total Number Required
20' x 8' Dry Cargo	27,240
20' x 4' Dry Cargo	8,175
20' x 8' Refrigerated	2,351
TOTAL	37,766
TOTAL in 20' x 8' equivalentents	33,679

Table 6-4. Total Container Requirements
By Type

The number of chassis required for support of the total of 37,766 containers in the entire system can be estimated from the 75-day turnaround time of containers (40 days at sea and 35 days on land). During the land based period, the containers should be normally on chassis, resulting in a minimum requirement for 17,568 chassis (CONUS and overseas). However, since any slippage in turnaround time will normally occur on the land based portion of that time, there should be an additional 25 percent of the minimum number of chassis, or a total of 21,960 chassis.

Summation of Requirements

Thus, the major items of equipment required for the support of an operation such as described, under conditions of maximum containerization can be summarized as follows:

1. 10 selfsustaining containerhips, each with capacity for 850 containers

(20' x 8' x 8' equivalents) or comparable total capacity in self-sustaining containerhips of other capacities.

2. 6 roll-on/roll-off cargo ships, each of approximately 15,000 measurement tons capacity (similar to the ADMIRAL WILLIAM M. CALLAGHAN) or equivalent capacity in roll-on/roll-off ships of other sizes.
3. 6 self-propelled lighters, each capable of carrying 6-20' x 8' x 8' containers, or 6 barges of equal capacity and 3 tugs or equivalent capacity in other sizes of lighters or barges and tugs.
4. 4 land based mobile cranes, capable of removing loaded 20' x 8' x 8' containers from barges or lighters at the shore line.
5. 2 Beach Discharge Lighters (similar to the LT. COL. JOHN U.D. PAGE), or equivalent capacity in lighters of other sizes capable of performing the same function.
6. 1 portable type pier, approximately 700' by 90', complete with reinforced decking, 2 gantry cranes and 2 roll-on/roll-off floating interface units.
7. Approximately 38,000 twenty foot long containers in the mix described above (there is only limited substitutability of larger lengths because of density, and combat handling requirements).
8. Approximately 22,000 container chassis, suitable for 20' long x 8' wide containers.

Much of this equipment would be required to be operational at the beginning of and during the 90-day buildup period. All of the equipment to be in operation, would be required by the end of approximately 5 months. The reliance on commercial support

by contract or other means, to produce the level of support equipment within these time frames is not realistic. Thus, it would appear that the DOD should own or have guaranteed rapid access to all of this equipment without recourse to procurement procedures.

It is probable that all of this equipment cannot be used in peacetime in such a way as to be economically justifiable without jeopardizing its availability for its primary mission of contingency support. Thus, it may be necessary to maintain some of the equipment in a standby status. For example, the use of the containerships and containers for support of U.S. Forces worldwide implies the risk of non-availability, parallel to that which would face a commercial operator with a contract to provide these equipments and/or services on immediate notification. It is possible that the containerships might be engaged in support of U.S. Forces in selected areas and still be available for loading for contingencies within the required time. However, such a rapid assembly of these assets might result in a high percentage of the containers being stranded.

It is possible that the containerships and RO/RO vessels could support U.S. Forces in selected areas. These areas should normally be on trade routes permitting rapid movement to a marshalling area for contingency support, and where commercial support could provide a lift capability if service is interrupted.

Some containers could be used for CONUS movement which would permit rapid assembly at the marshalling area. Additionally, containerizable unit move equipment, binned storage and other similar supplies should be prepacked for the strike force units and held ready for immediate outloading. The auxiliary

equipment (piers, gantry cranes, lighters, mobile cranes), should also be maintained in a readiness condition for rapid deployment.

Other alternatives may be available. Agreements with commercial operators for provision of a specific number of containers within a specified time period might be possible. Lease-back arrangements with commercial operators, with provision for rapid recall, present another possible alternative. Whatever the alternative, however, rapid support of deployed forces by the most efficient and effective means requires rapid access by the military to the containers and related equipment required for a full container support operation.

CHAPTER 7

**LESSONS LEARNED
AND POLICY IMPLICATIONS**

CHAPTER 7

LESSONS LEARNED AND POLICY IMPLICATIONS

ISSUES

In the preceding chapters, a review of container operations in Vietnam during the 1965-1968 time period has been made. The measured effect of containerization that occurred, and the potential effect that full containerization could have had has been analyzed. Similarly, containerization impacts on equipment and facilities used in the supply distribution function have been analyzed in terms of what actually occurred and what would have occurred under a full containerization concept. These analyses have included time, performance, quantities and costs as parameters.

Current management and operating policies and procedures relating to containerization have been reviewed. Major areas in which future policy is required and must be provided have been identified. Finally, the implications of military control and ownership of a support capability for contingency operations have been addressed.

The objective of the preceding analyses has been to identify the lessons learned which will permit future improvements. These include analyses of both the capabilities and limitations related to the procedures, equipment and facilities used in the Vietnam operation, and the basic factors underlying their performance.

In this chapter, the issue addressed may be stated as: "What lessons learned and policy inferences can be drawn from the preceding analyses and the developments foreseen for the 1970-80 timeframe?"

CARGO DISTRIBUTION AND
LOGISTIC EFFECTIVENESS

Lessons Learned (Operational)

<u>Page Reference</u>	
2-2,2-8 2-19,2-21 2-46 - 2-48 3-3 - 3-6 3-19 - 3-24	1. The use of the Conex container and the large intermodal container in the Vietnam operation clearly demonstrated the advantages of containerized over breakbulk shipments. Principal advantages were their flexibility in unitizing cargo lots of different size and shape, protection to the contents of the box against loss, damage and pilferage, and reduction in handling required through the single lift of the box and its contents.
2-2,2-9 2-48,2-72 3-25	2. The larger intermodal containers are more effective and efficient. Larger size permits unitization in larger increments, and increases the scope of commodities which are containerizable. Their standardized design features permit rapid handling. Intermodal design also permits better vehicle utilization, with the container and chassis designed as compatible units.
2-13 - 2-17	3. Approximately two-thirds of all cargo moved to Vietnam by surface lift in the 1965-1968 time period (excluding bulk dry and bulk POL) was containerizable. Major exceptions were Class VII End Items and some Class IV Construction Items. These could all have been carried on RO/RO ships, thus eliminating the requirement for breakbulk ship support, had sufficient containers, containerships and RO/RO ships been available. A heavy lift capability would have been required for loading and unloading very dense cargo (locomotives, etc.) on RO/RO ships.
2-11	4. Substantially all airlift cargo in the Vietnam era was containerizable.

Page
Reference

2-8,2-17
2-18

5. Retrograde tonnage during the early stages of a contingency operation is negligible. Tonnages increase as the operation continues but represent a small part of total tonnage moved until a period of disengagement occurs. Retrograde tonnage from Vietnam in 1968 (the highest point in the 1965-1968 time period) was about 6 percent of tonnage shipped to Vietnam.

2-6
2-21 - 2-23
2-46,2-48
2-49,2-59
2-60,3-9

6. Breakbulk operation in support of a rapid buildup phase of contingency operation in undeveloped ports, with their concomitant weather problems, presents major difficulties. Port and depot congestion, excessive ship turnaround time, and inadequate data for supply location and stock control resulted from this situation in Vietnam.

2-8,2-9
2-19 - 2-23
2-31 - 2-33
2-46 - 2-53

7. The expansion of Conex support and the initiation of contractual intermodal container service to Vietnam proved helpful in resolving the problems noted above. However, only about 10 percent of the total containerizable cargo moved to Vietnam in 1968 was carried by intermodal containers. Container movements of a higher percent of such cargo would have increased such gains.

2-9
2-46 - 2-53
2-21,2-22
4-63,4-64

8. Rapid port development is required for the most effective use of containers. Containerization was not introduced into Vietnam until permanent port facilities had been constructed.

2-35 - 2-39

9. The number of containers required to support a full containerization concept for support of a contingency operation relates to the stage of the operation and its size. In Vietnam during the 1965-1968 period, the total number of 20' equivalent containers required

Page
Reference

- would have ranged from about 16,000 in 1965 to about 82,000 in 1968, consisting of dry and reefer cargo containers and some 4' high gondola containers for very dense cargo. (See Table 2-5, P 2-39).
10. Operations in most oversea areas can be supported through the use of normal commercial booking arrangements. In 1968, DOD commercial container movements to areas other than Vietnam exceeded container shipments to Vietnam by a factor of about three. Container operations to these other areas (principally USAREUR and USARPAC less RVN) presented no problems to the local Commanders.
- 2-39 - 2-45
11. The major increase in port throughput capacity resulting from containerization reduces port requirements. In Vietnam, 34 deep-draft berths were in use by 1968. Under a full containerization concept, and with non-containerizable cargo moved by RO/RO ships, this requirement could have been reduced to 14 berths.
- 2-48 - 2-53
12. Containers have wide application for other than cargo movement. Conexs were used extensively in Vietnam as a substitute for conventional covered storage. Intermodal containers are even more suitable for this purpose because of their greater size and mobility.
- 2-19, 2-54
2-56 - 2-60
3-13 - 3-16
5-11, 6-25
13. Block stowage in containers of cargo requiring covered storage permits rapid location and issue of supplies, eliminates rewarehousing and often allows issue of the entire container to the user intact. Of the total cargo shipped to Vietnam in the 1966-1968 period, 38 percent was dry cargo requiring covered storage. Fifty-nine percent of this amount was
- 2-57 - 2-60
3-5, 3-21

Page
Reference

- suitable for block stowage. Application of 20' equivalent containers as rotating storage facilities for these supplies would have required 49,200 containers and would have provided the equivalent of 6,300,000 square feet of conventional covered storage.
14. Refrigerated storage is a problem in contingency operations, particularly in hot climates. In Vietnam, unloading of breakbulk reefer cargo was frequently interrupted by requirements to close reefer holds to restore suitable temperatures. Spoilage of cargo occurred under the best of conditions. Inadequate shore based storage facilities also required the use of reefer ships as floating reefer storage facilities.
15. The reefer container provides a readily redeployable reefer storage facility. Of all cargo shipped to Vietnam in the 1966-1968 period, 3.8 percent was reefer cargo, all of which could have been stored in reefer containers. Storage in this mode would have required about 4,300 20' equivalent containers, would have met all requirements for reefer storage, and the necessity to use ships on a demurrage basis as storage facilities.
16. The use of Conex containers as a substitute for other facilities, such as administrative buildings, orderly rooms, mail rooms and similar uses demonstrated the potential of larger mobile intermodal containers.

Page
Reference

2-65, 2-66
5-6

17. Conex application as a binned storage facility was a highly successful means of moving a section of a depot to the user in Vietnam. The use of larger mobile intermodal containers would permit expansion of the concept, allowing binning of a wider range of repair parts, and items of larger sizes. Application in support of contingency operations calling for rapid unit moves would be particularly valuable.

18. Unit supply, in terms of direct throughput of supplies from a CONUS point of origin to the user, would produce major benefits in supply operations. Containerization can provide this capability for some types of supplies and users.

2-66 - 2-71
5-6

Preloading of subsistence in containers on a "ration" basis rather than a ration component basis would allow issue of a container with a given number of man days of a ration to a user. This procedure would eliminate ration breakdown requirements in the theater and provide the ration control point in the theater with a mobile inventory capable of immediate movement. It would eliminate facility requirements, reduce pipeline and manpower requirements, and speed distribution. It would require removal of the ration breakdown function from the theater to the point of origin, where it could be accomplished more efficiently.

The concept with slight modification could also be applied to such commodities as packaged POL, ammunition, Post Exchange items, and some levels of repair parts users.

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Reference

2-71, 2-72
5-7

19. The use of Conex containers to support unit moves to Vietnam demonstrated the applicability of containerization to support this requirement. From 1966 through 1968, over 21,000 Conex containers were used in unit moves. The use of a mix including larger intermodal containers for this purpose would increase unit mobility, permit better packing and fewer loads.

Lessons Learned (Resource Effectiveness)

1. Maximum containerization produces significant dollar savings in both recurring and one time cost avoidance. Major areas of savings are:
 - a. Shipping
 - b. Cargo handling
 - c. Pipeline
 - d. Port facility requirements
 - e. Covered storage requirements
 - f. Refrigerated storage requirements
 - g. Pilferage, loss and damage.

3-2 - 3-19

One time cost avoidance savings which could have been obtained by maximum containerization in support of Vietnam for the 1965-1968 period amounted to \$528 million; recurring savings for the four years would have amounted to \$354 million, a total of over \$880 million. At the 1968 level of activity, annual recurring cost savings would amount to \$120 million. Pilferage, loss and damage savings are not included in the above estimates, but probably range from 5 percent to 10 percent of the value of cargo shipped.

Page
Reference

2. Maximum containerization reduces manpower requirements in several logistic support areas. Major areas of savings are found in the following activities:
 - a. Port handling
 - b. Depot handling
 - c. Construction

As with dollar savings, manpower savings fall into one time and recurring categories. For the 1965-1968 period with full containerization, one time manpower savings would have amounted to 4.4 million manhours and recurring savings to 28.6 million manhours, a total of 33.0 million manhours. Annual recurring savings would equal 9.8 million manhours at the 1968 level of activity.
3. Reduction in manhour requirements reduces requirements for in-theater contract labor, thereby permitting better control and greater flexibility in operations. Lost time by contract labor resulting from holidays, riots and periods of crisis such as the 1968 Tet offensive during the Vietnam operation could have been reduced or eliminated by reducing the necessity for reliance on contractual support.
4. Maximum use of containerization has a major impact on the timetable related to a contingency buildup. During the 21-month rapid buildup period from April 1965 through December 1966, troop strength in Vietnam increased by about 310,000 men. Under full containerization, with RO/RO support and assuming a 90-day LOTS operation, pending adequate deep draft berth and pier capability, the cargo distribution capability would have permitted this buildup in six months, including unit move and resupply requirements. In

3-19 - 3-25

3-19, 3-20

3-25 - 3-35

Page
Reference

the case of Vietnam, full containerization would have provided the Commander with the potential of approximately 61 percent more man years of troop availability in the theater.

Future Trends

1. Cargo characteristics for support of field units are not expected to change measurably in the 1970-1980 time period. Approximately 70 percent of all cargo can be expected to be containerizable, and remaining cargo can be efficiently moved on RO/RO ships. Reefer cargo will continue to be moved to support field units and will require special transportation and storage facilities.
2. Cargo containerization in commercial operations will continue to increase and will result in a significant reduction in breakbulk shipping.

Policy Implications

1. Containerization should become the accepted way of moving cargo. Planning should be based on maximum use of this concept augmented by RO/RO support for non-containerizable items.
2. Port development planning for contingency operations should be based on the rapid development of a minimum number of ports (consistent with the tactical situation), capable of handling container and RO/RO ships, rather than on a multiplicity of ports to support breakbulk ships.

Page
Reference

3. Container requirement analyses and DOD policy should be based on the use of containers for purposes other than cargo carrying, including covered storage for dry cargo, storage for reefer cargo, modules for various administrative facility requirements, binned storage facilities, and pre-packed unit move supply modules.
4. The application of unit supply support by throughput from CCNUS origin direct to user should be investigated and necessary actions taken to test and implement the concept. Subsistence and packaged POL would appear to be suitable commodities for testing the concept.

FACILITIES AND EQUIPMENT

Lessons Learned - Ocean Transport

<u>Page Reference</u>	
2-46	1. Rapid deployment and effective support in a contingency situation requires rapid access to and use of a cargo fleet with high delivery capabilities. Vessels available to the MSTS during the Vietnam era were, for the most part, breakbulk cargo ships. The MSTS owned and controlled vessels (Nucleus Fleet and General Agency Agreement ships) were breakbulk ships, many of which were obsolete and in poor condition. Legal authorization for emergency requisitioning of commercial ships existed but was not used.
4-1 - 4-6	
6-3 - 6-5	
6-9, 6-10	
2-2, 2-3	2. The ratio of containerships to breakbulk ships has increased rapidly since 1960. Current ship construction and conversion programs indicate that this trend will continue. In 1959, containerships represented an insignificant portion of the U.S. Flag fleet. By late 1968, they represented over 40% of the number of vessels and total tonnage of the fleet.
4-7, 4-14	
4-15	
5-6, 5-12	
2-21 - 2-26	3. Containerships provide the means to move cargo rapidly to and through port terminals. Their prompt military use in contingency operations generally require that they be selfsustaining. Both selfsustaining and non-selfsustaining ships were used in the RVN operation. Requirements for pier improvement and crane installation permitted operations by selfsustaining ship about 90 days earlier than by non-selfsustaining ships.
2-47, 2-48	
4-6 - 4-8	
4-17 - 4-22	
4-46	
2-47	4. Roll-on/roll-off type vessels, including seatrains, were highly successful in moving wheeled and tracked vehicles. Stowage of supplies aboard the vehicles before loading increased ship utilization. These vessels were particularly advantageous for short distance operations with several ports of call, and can be used to move containers on chassis, when required.
4-24 - 4-32	

Future Trends - Ocean Transport

Page Reference

1. During the 1970-1980 timeframe, an acceleration in the transformation of the U.S. Flag fleet from a break-bulk to a containerized transportation system can be expected. The fleet will contain large, fast vessels many of which may have a capability to handle containers of varying dimensions in different combinations. Because of the economic considerations, the container fleet will be, for the most part, non-self-sustaining.

2. Conventional containerships in the U.S. Flag fleet will be supplemented by an increasing number of vessels which employ the "lighter aboard ship" (LASH) concept. These ships will have the capability to carry cargo in lighters or barges which in turn are carried aboard the ship to the destination area. The concept of loading and discharging individual lighters at several points reduces port congestion; the barges provide automatic lighterage facilities for unimproved port areas. The capabilities of these ships are important in military contingency operations, particularly for the over the shore operations required while adequate berths and piers are being constructed, and for coastal and inland waterway distribution of cargo.

3. Roll-on/roll-off ships will continue to become increasingly available (principally as combined container/RO/RO vessels) in the U.S. Flag fleet and their requirement in support of military operations, particularly for unit moves involving vehicular equipment, will continue.

Policy Implications - Ocean Transport

Page Reference

1. The use of emergency requisitioning authority cannot be assumed for future contingencies.
2. The trend toward a U.S. Flag merchant fleet consisting primarily of containerships must be recognized and DOD policy aligned toward this posture. This implies the use of containerization on a large scale by the military establishment, and an assessment of the necessity of further retention of the National Defense Reserve Fleet of breakbulk ships. Arrangements and policies, in addition to emergency requisitioning authority, are required, which will permit prompt and guaranteed access to an adequate number of ships to support contingency operations.
3. The trend to non-self-sustaining containerships is generally not compatible with military requirements for support of contingency operations. Ship conversion concepts to make non-self-sustaining ships self-sustaining through quick modification should be pursued to insure that an adequate number of self-sustaining containerships are available in the U.S. fleet to meet military requirements. Application of LASH type ships for container movements should be studied.
4. The continuing requirement for roll-on/roll-off type ships should be recognized and appropriate actions taken to insure that an adequate number are available for military support.

Lessons Learned - LCIS Operations

- | | |
|-------------|---|
| 2-7,2-46 | 1. Contingency operations must anticipate major requirements for over-the-shore movement of cargo. The lack of adequate |
| 4-32 - 4-35 | |
| 6-12,6-13 | |

Page
Reference

3-29, 3-30
4-32 - 4-36
6-22

pier facilities in the early days of the Vietnam operation and lack of secure land transportation produced major requirements for cargo LOTS operations.

2. Lighters and other equipment used in LOTS operations under contingency conditions should be of standard configuration, modern, in good readiness condition and designed to meet container and RO/RO movement requirements. The equipment available in Vietnam, particularly during the early buildup period was in poor condition and much of it non-standard. Consequently, maintenance requirements were heavy and downtime rates high. The equipment available could handle breakbulk and roll-on/roll-off cargo (including containers on chassis), but was not designed nor used to move demounted containers.

3-29, 3-30
4-32 - 4-36
6-22

3. Lighters and other equipment available in Vietnam by 1968 were capable of handling breakbulk and roll-on/roll-off cargo in a LOTS operation. Roll-on/roll-off discharge equipment could handle containers on chassis. None of the equipment was designed for landing of demounted containers and demounted containers were never offloaded in this mode.

Future Trends - LOTS Operations

1. The lighter aboard ship (LASH) concept, discussed above, has direct application to over the shore and inland waterway operations. These ships permit the movement of loaded containers for discharge at the destination site. Adequate interface equipment, such as mobile cranes or high capacity rough terrain forklifts will be required

Page
Reference

for the transfer of the containers from the barges to the chassis.

2. The use of heavy lift helicopters for ship discharge is currently under study. Heavy lift helicopters (18 to 25 tons) capable of lifting intermodal container size loads, are currently in research and development and may be available during the 1970-1980 time period. This means of discharge will probably require the use of self-sustaining ships to move containers on deck, as the lift of containers by helicopter from cell structures in the hold of containerships, is possible only to a limited degree. A major advantage of the helicopter offload system is the elimination of the shoreline interface, permitting a single move of the cargo to an optimum marshalling area. This method eliminates port congestion but is relatively slow compared to other discharge methods.
3. The ground effect machine (GEM) is currently being produced in sizes large enough to accommodate containers. GEMs are capable of high speeds over both land and water and, as with the helicopter, eliminate shoreline interface problems. The GEM, however, requires relatively smooth terrain, and thus, its use in some areas of contingency operation might be limited. It should, however, be recognized that GEMs are still, to a large degree, developmental.

Policy Implications - LOTS Operations

1. Efficient and effective container operations in support of a contingency require the capability to move containers

Page
Reference

rapidly from ship to shore in an environment where pier facilities may be limited or non-existent and an inland transportation infrastructure not available for use. There is a requirement that DOD place emphasis on the development of such capability to insure its availability in sufficient quantities and in adequate readiness to support deployment requirements.

2. Particular emphasis must be placed on the ship/shore interface problem. Equipment development should be pursued vigorously and validated by test. This should include methods for both emergency and sustained LOTS operations to include the heavy lift helicopter, ground effect machines, and mobile container discharge capability. Major alternatives currently under study by the Services are illustrated in Figure 7-1.
3. The entire harborcraft support fleet capability should be reviewed to determine updating and standardization requirements to provide a modern fleet compatible with container support of a contingency operation. Reserve stocks of such equipment should be established and maintained in a high state of readiness.

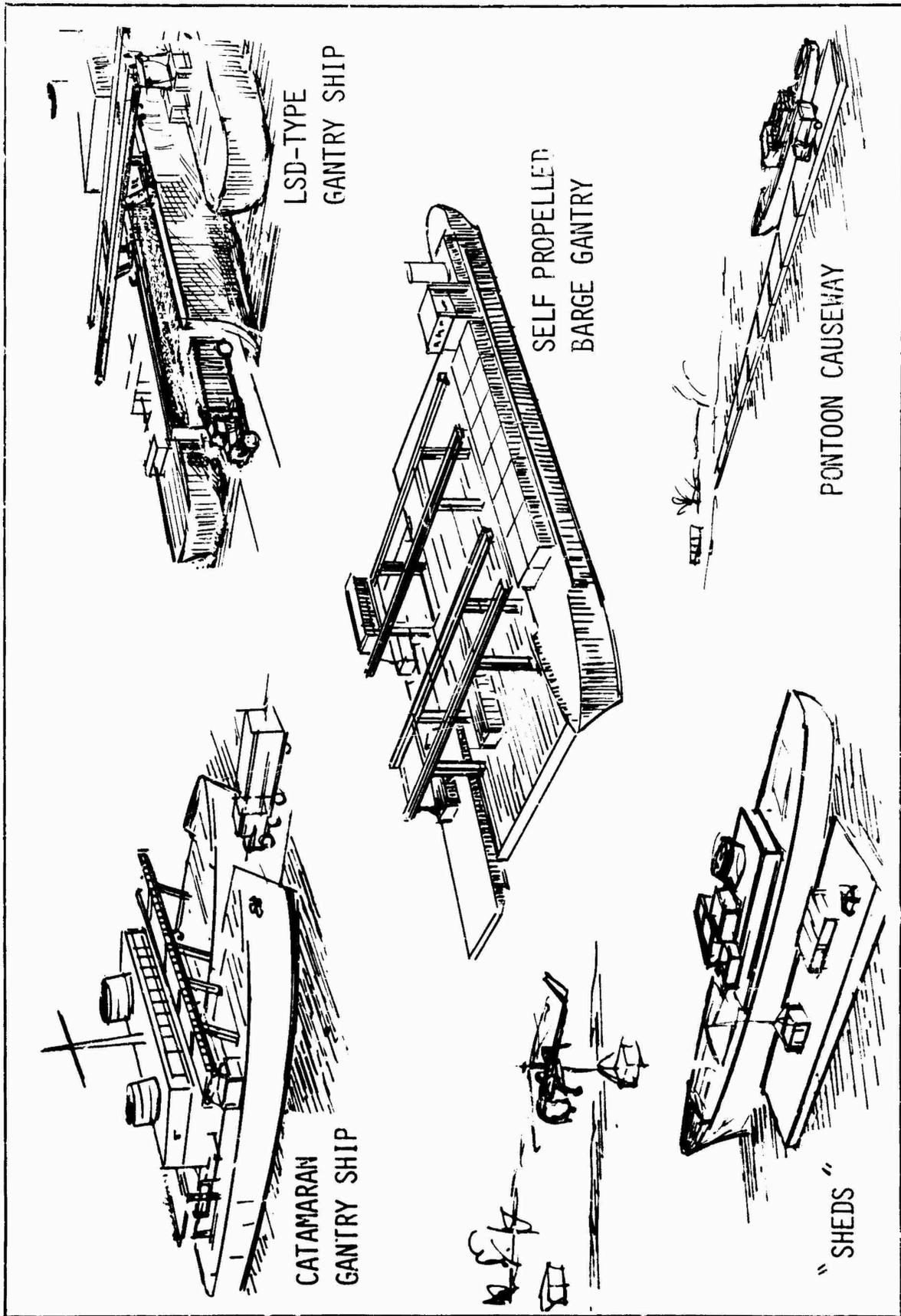


Figure 7-1. Alternative Ship-Shore Interface Modules

Lessons Learned - Land Transport

- | <u>Page Reference</u> | |
|-----------------------|---|
| 4-39 | 1. Weight and size limitations on container loads pulled by a single tractor over most U.S. highways, precluded the increased economy and effectiveness which could be obtained through hauling two or more vans in tandem. |
| 4-39 | 2. Efficient container operations required that sufficient chassis be available to match containers arriving at a port on a one for one basis. |
| 4-40 | 3. Military tractors used to move container vans in contingency operations must be capable of hauling such loads over poor roads and in mountainous terrain. Military tractors used to move heavy loads in Vietnam (the M52 military tractor) were found to be generally inadequate under these conditions. |

Future Trends - Land Transport

1. The increased use of double and triple bottom combinations for highway movement of containers will probably increase. Currently, 32 states and 5 turnpikes permit "double bottom operation". Triple bottom combinations have been approved in Oregon and tests are being conducted in other states. It is possible that by the mid-70's, Federal Legislation may permit double bottoms on all interstate highways.^{1/}

^{1/} Annual Review of Transportation Trends, FY 1969, Headquarters, MTMTS, 30 September 1969.

Policy Implications - Land Transport

Page Reference

1. Military highway equipment capability for moving containers in probable contingency areas should be reviewed and appropriate action taken to secure additional and more suitable equipment.
2. In DOD container operations, whether by contract, sole source agreement or military ownership, sufficient chassis should be provided to insure prompt container movement at port areas. Normally, this requires a chassis for every arriving container.
3. DOD support and encouragement should be provided to those programs which will improve rail and highway capability for movement of cargo by containers.

Lessons Learned - Airlift

1. Unitization and containerization of airlift cargo increases the efficiency of air cargo movement by promoting more rapid aircraft turnaround. The use of containers (although not intermodal) increased rapidly during the Vietnam period, both in the commercial and military applications. The Air Force 463L pallet was used extensively in support of Vietnam operations.
2-3, 2-4
2-11, 2-12
4-40, 4-41
4-64, 4-65
2. Capability to airlift intermodal containers would have resulted in reduced aerial port congestion and aircraft turnaround time in the Vietnam operation.
4-40, 4-41
4-65

Future Trends - Airlift

Page
Reference

1. Large aircraft, capable of carrying intermodal containers in quantities, are about to begin operations and will operate on a large scale in the 1970-1980 time frame. The C-5A (and its commercial L-500 counterpart) and the Boeing 747C are examples. The C-5A has the capability of lifting twelve 20 foot equivalent containers and can carry 220,000 pounds 2,700 miles without refueling. Both the L500 and B747C can carry 14 20 foot equivalent containers over long distances. These aircraft provide a major advance in airlift support capability for deployment operations. They are configured for most vehicles in the military system.

Policy Implications - Airlift

1. Maximum application of intermodal container movement concepts should be applied to airlift with the advent of the 1970-1980 capability.
2. A thorough study of optimum cargo eligibility for airlift with the new aircraft and their increased container carrying capability is required. Many current criteria will be outmoded.

Lessons Learned - Interface Equipment

<u>Page</u>	
<u>Reference</u>	
4-41 - 4-47	1. Container operations produce major requirements for many types of interface equipment, both for loading and unloading the container and lifting and moving the container itself. Proper interface equipment is essential to an effective container operation.
4-46	2. Interface equipment for container support of contingency operations must be available in adequate amounts and types. It must be designed to withstand high workload requirements typical of such an operation and the environmental extremes which may be encountered. When carried in reserve stocks it should be maintained in a high state of readiness. Interface equipment used in container stuffing and unstuffing during the early days of the Vietnam operation presented serious problems because of the equipment shortages, excessive maintenance requirements and high downtime levels.
4-46	3. Interface equipment must be compatible with the size of the container. Thus most forklift trucks in Vietnam could enter the Sea-Land van, but many would have had difficulty in entering an 8' high container.
4-44 - 4-46	4. Large, heavy lift equipment is required for lift and transfer of the complete container at all interface points, including sea and aerial port depots, and CONUS and contingency marshalling areas.

Future Trends - Interface Equipment

Page
Reference

1. A considerable amount of effort has been and is being devoted in the commercial sector to the development of container handling equipment (both air and surface). It can be assumed that during the 1970-1980 time period additional improvements will be made to both container stuffing and unstuffing, and in the container lift and transfer elements of the interface system.

Policy Implications - Interface Equipment

1. A review of interface equipment capability to support contingency operations is required to determine qualitative and quantitative requirements for satisfactory performance in a contingency situation and compatibility with large scale container operations in such an environment.
2. An adequate supply of heavy lift equipment (gantry cranes, mobile heavy lift cranes) and other types of interface equipment required for container operations should be held in reserve stocks for rapid deployment in support of contingency operations.
3. Commercial advances in the state-of-the-art of interface equipment should be under continuing review and advances applicable to military operations adapted promptly.

Lessons Learned - Containers

4-22, 4-23
4-51 - 4-59

1. Many current intermodal containers do not conform to standard dimensions, although standards have been prescribed for intermodal containers by the

Page
Reference

United States of America Standards Institute and the International Standards Organization. The two largest container operators (Sea-Land Service, Inc. and Matson Lines) use containers which do not comply with the ASI and ISO standards.

- 4-53 - 4-59
2. Container width standards (8 feet) are generally observed by all container operators. Height and length standards vary, with major variation in the length. The reasons are largely economic and the size of the investment in the non-standard containers indicates their use will continue.
- 4-22, 4-23
4-53, 4-58
4-59
3. The lack of standardization currently reduces interchangeability of containers among container operators. Containers used in Vietnam were non-standard, but since they were the only containers used in the theater, this produced no problem. However, had it been necessary to contract further support with another container operator, the lack of interchangeability might have created problems.
- 4-59
4. The use of intermodal containers in Vietnam was limited to the transportation element of the total cargo distribution function. A quick means for modification of intermodal containers for other purposes would have assisted in resolving some of the logistic problems of Vietnam.
- 4-52
5. Although, as noted earlier, intermodal containers were not used for air shipment, an Air-Land specification has been approved for such containers, with size dimensions matching the USASI and ISO standards.
- 4-59
6. Blocking and bracing of cargo within the container was time consuming under field conditions. The most common method involved the use of wooden dunnage. Prefabricated gates, pneumatic dunnage, tie-down rings and other devices would reduce

Page
Reference

2-15, 2-35
2-36,
4-47 - 4-51
4-56, 4-57

time and skill levels required for adequate cargo stuffing and securing.

7. Military requirements indicate a need for standard intermodal containers of various configurations, including various lengths, heights and features to match cargo characteristics and the lift, transfer and transport capability of the user.

Future Trends - Containers

1. The use of containers of various dimensions will continue through the 1970-1980 time frame. However, as noted earlier, the problems of moving these various sized containers may well be alleviated by the construction of ships capable of carrying mixed loads of different size containers.
2. Air-Land container production will provide containers specifically tailored to airlift load criteria. The containers will be on modules ranging from 10 foot through 40 foot lengths and will probably be of lighter construction to reduce the tare weight factor in airlift operations.
3. The number of containers available in the U.S. container fleet will increase as more operators convert to container movements and as operators currently using containers expand their operations.

Policy Implications - Containers

1. The production of quick modification kits for containers to provide for multi-purpose use should be considered. Mountable and demountable binning tailored to the container, removable panels to permit windows, personnel doors and skylight, and movable compartment dividers would facilitate the use of containers as binned storage facilities, administrative facilities and other purposes.

Page
Reference

2. Engineering research should be devoted to improving the technology for the rapid and economical loading, discharge, and secure stowage of container contents, including the application of modular inserts, palletization and restraints.
3. Contingency planning must consider the impact on the distribution system of containers' non-standard dimensions if the use of more than one type of commercial container operator is contemplated.
4. A thorough study of container requirements in terms of configurations best suited to military cargo characteristics and military operational requirements should be made.

Lessons Learned - Depot Facilities

- 4-60 1. Large scale container operations require large improved marshalling areas for holding containers at both loading and unloading facilities prior to their movements.
- 4-61,4-62 2. The compatibility of the depot container interface at the loading/unloading dock is important. Depot loading and unloading facilities, particularly in Vietnam, were frequently not well designed for container operations. The physical separation of the loading dock from the warehouses required multiple handling of all cargo after its arrival. Additionally, varying loading dock heights were frequently not compatible with the container height.
- 4-60,4-61 3. Conventional packing, packaging, and receiving and shipping functions would be affected by maximum containerization and throughput procedures. Prepacking for direct shipment to the user would influence both shipping and receiving functions and would reduce the amount of packing and packaging required for protection. Container block stowage and prebinning would also reflect these procedures

Future Trends - Depot Facilities

- | <u>Page
Reference</u> | |
|---------------------------|---|
| | 1. The commercial use of consolidation points for container stuffing of cargo from two or more points of origin will probably expand. |
| | 2. Current efforts by all military departments to produce improved inventory location, and to automate shipping and receiving will permit faster requisition processing, stock selection and cargo loading. |

Policy Implications - Depot Facilities

1. Depot construction and renovation programs should be related to large scale container operations, particularly at the loading and unloading interface.
2. Research to establish optimum packing and packaging criteria for container shipments should be continued and maximum emphasis placed on their completion. Substantial savings in space, time and dollars can accrue from such a program.
3. Studies to determine the types of supplies and the procedures suitable for throughput shipment from origin to user should be continued, with high emphasis placed on their completion followed by test and full scale implementation.

Lessons Learned - Port Facilities

- | | |
|--|--|
| 2-49 - 2-53
3-29, 3-30
4-62 - 4-64
6-13 | 1. Ports (sea and aerial) require large improved marshalling areas for container holding. Deployable piers for deep draft container vessel discharge should be brought into being. The use of LASH type vessels to transport mobile pier sections and other equipment required for rapid port construction should be investigated. |
| 4-63, 4-64 | 2. Experience at Subic Bay showed that containerization reduced pier congestion, |

Page
Reference

- eliminated a requirement for increased transit shed facilities, increased port throughput capability, reduced port throughput time, and reduced the backlog of ships awaiting discharge.
- 4-64, 4-65 3. Similar results could be expected from large scale container operations at aerial ports. Reduction in port congestion, aircraft turnaround time, and improved port throughput would result from containerization.

Future Trends - Port Facilities

1. Commercial marine and air terminals in the 1970-1980 period will be highly automated with shore based containership loading and unloading capability. A high percent of cargo passing through the ports will be containerized.
2. The advent of LASH type vessels will reduce port congestion to some degree at major ports and expand the use of inland ports, both in the U.S. and overseas.
3. Commercial ports in the United States and on the major trade routes to foreign countries will be equipped generally to handle nonself-sustaining vessels. Smaller ports located off main trade routes will probably not have this capability.

Policy Implications - Port Facilities

1. Aerial and seaport planning must be based on the concept of a high and rapid container throughput requirement.
2. Contingency planning must include the requirement for rapid seaport and aerial port construction in unimproved areas to include an integral capability for support of container cargo distribution methods.

Lessons Learned - System-Wide Considerations

- | <u>Page Reference</u> | |
|-----------------------|--|
| 4-65 - 4-69 | 1. Containers, and the family of equipment associated with container operations, must be designed to operate in each of the environments in which it will function within the total distribution system. |
| 4-65 - 4-69 | 2. Reliable information regarding transportation environments (natural and induced) is required for effective container operations and intermodal transportation equipment requirement determinations. |

Future Trends - System-Wide Considerations

1. Increasing emphasis will be given to the transportation environment, both for normal commerce and for the transportation of hazardous materials

Policy Implications - System-Wide Considerations

1. A system approach to transportation environments affecting containerization is recommended. Interim and long-run environmental standards are feasible and should be developed. Acquisition, validation and application of data to produce such standards should be pursued.
2. Standards for packaging and container design should be related to factual environmental and economic criteria based on system-wide analyses of tradeoffs. The entire movement cycle to include distribution, handling and storage must be considered.

MANAGEMENT AND CONTROL

Lessons Learned

Page
Reference

1. The introduction of the intermodal container into the commercial and the military transportation/distribution systems created a need for Federal and DOD policies. Existing policy directives dealing with cargo movement are oriented to individual transportation modes rather than to a throughput containerized distribution system.

No comprehensive DOD programs, directives, or regulations dealing with intermodal containerization as such were published during the Vietnam era. DOD components and agencies did, however, take actions related to containerization which provide a basis for ultimate DOD containerization programs and policies.

5-2 - 5-17
2. The present segmented and mode oriented approach to the management of containerized cargo movement tends to militate against the attainment of overall cost and effectiveness benefits. This indicates a need for systems management with centralized policy control and decentralized management of operations. The total system concept was found to be essential in gaining optimum benefits from throughput containerized cargo movement.

5-15
5-19 - 5-25
3. The use of large intermodal containers in Vietnam was maintained as a contract operation with applications strictly controlled to the wholesale distribution system. Military personnel did not gain "hands on" management experience in specifically military applications.

5-28, 5-29
5-34

<u>Page Reference</u>	
5-10, 5-24 5-32, 5-33	4. In spite of advances in containerization within the commercial sector, problems exist in military containerization management in such areas as size standards, container interchange and sharing, rate structure, and retrograde movement.
5-28, 5-29	5. The U. S. Army Materiel Command Milvan Pilot operation is the only significant container program scheduled that appears to be capable of providing practical experience in many areas of containerization management and of supporting advances in concept for military container operations.
5-26 - 5-31	6. DOD performance accounting and reporting, oriented towards vertical command operating program and budget structures, did not provide required visibility of the throughput system as a whole.
5-19 - 5-22 5-41	7. Experience with worldwide Conex control suggests that management control must reconcile system wide the conflicting demands of transportation with field facility uses of containers.
5-41, 5-45	8. The movement priority and documentation system generally accommodated intermodal containerized movement. UMMIPS stage wide standards for movement performance did not recognize system wide trade-offs arising from container cargo consolidation.
5-45 - 5-50	9. Cargo documentation practices showed a need to:

Page
Reference

- a. Relate supply documentation to transportation documentation using such cross-reference media as the container serial number, the Transportation Control Number (TCN) and the vessel voyage number.
 - b. Improve intransit cargo visibility.
 - c. Simplify in-theater cargo receipt accounting processes.
 - d. Reduce paperwork at all nodes.
10. There are apparent conflicts in responsibility involved in throughbill of lading/through intermodal container operation (TGBL/TICO), between MTMS and MSTS, which required ad hoc DOD guidance for resolution.
- 5-36 - 5-40
5-57
11. Experience in RVN indicated a need to clarify responsibility for container operations responsibilities; both water terminals and depots are reluctant to perform container unstuffing for the purpose of further onward movement in the breakbulk configuration.
- 5-40,5-41
5-56

Future Trends

1. National transportation and distribution policy actions already in motion will produce:
 - a. A greater facilitation of intermodal operations
 - b. Extensive interchange of management and technological information
 - c. Acceptance of containerization as the norm rather than the exception
2. Management systems--both military and civilian-- will continue to emphasize:

Page
Reference

- a. Central visibility, with information access at each level
 - b. Minimization of materiel in pipeline and in the hands of the user
 - c. Increasing application of quantitative goals and standards, together with management information systems to display them.
3. Increased availability of high performance communications can be expected as a consequence of current developments in Autodin and automated address systems, among others
 4. Intensive management automation using computers will provide operating systems with the capability for:
 - a. Increasing compatibility of information --particularly, information relating transportation and supply (TCN versus FSN)
 - b. Providing direction to subordinate levels in terms of tasks to be accomplished
 - c. Balancing of resource allocation for maximum system efficiency, as opposed to that of individual elements.

Policy Implications

DOD containerization policy and program considerations in the management and control areas should:

1. Establish a fully integrated throughput containerized common user cargo distribution system to:
 - a. Integrate the management of cargo movement and container fleets

Page
Reference

- b. Simplify current methods for obtaining commercial intermodal containers by the shipper.
 - c. Establish common user consolidation/distribution centers as required in CONUS and oversea areas for containerized cargo movement
 - d. Revise current accounting, performance and cost reporting of depot, terminal, land, ocean and air operations to permit throughput system-wide visibility on a consistent basis.
 - e. Assign and control the military-owned common user container fleet.
2. Establish a program to improve containerized cargo movement documentation with the following specific objectives:
- a. Insure the ability to relate detailed supply information to transportation information, using such cross-reference media as the container serial number, the TCN and the vessel voyage number
 - b. Improve intransit cargo visibility and tracing/diverting capability
 - c. Simplify in-theater cargo receipt and accounting
 - d. Base movement priority standards on measurements of system-wide performance rather than on individual stages
 - e. Provide in-theater availability of a fully operational ADP system, starting with initial operations.
3. Establish definitive policies and programs for early acquisition of a limited number of intermodal containers and related transport and materials handling equipment, and conduct tests and pilot operations in order to establish sound management and operating policies and procedures for the use of intermodal containers in all phases of logistics operations.

MILITARY OWNERSHIP AND
CONTROL CONSIDERATIONS

Lessons Learned

- | <u>Page
Reference</u> | |
|---------------------------|--|
| 6-1,6-11
6-12 | 1. A major requirement in meeting contingency requirements is rapid response at a strength level commensurate with the threat, and implies a corresponding rapid buildup of logistic support.

Analysis of the Vietnam operations indicates clearly that the logistic system which can produce most rapid response in a contingency, and which also provides the most efficient and effective support to military operations requires the use of maximum containerization. |
| 6-9,6-10 | 2. In the absence of an exercise of emergency requisitioning authority, other agreements between Government and commercial operators may not provide transport capability to meet contingency requirements, in time for meaningful support. This situation was true in the early stages of the Vietnam contingency. |
| 6-10 - 6-12
6-14 | 3. The time required to negotiate and implement the Sea-Land contract for commercial container support exceeded 12 months. It is essential that this time consuming element be reduced to the minimum possible. However, commercial support in sufficient quantity can probably be obtained after the contract and start up lead time. |
| 6-11 - 6-13
6-27,6-28 | 4. The government has a requirement for ownership of, or guaranteed access to sufficient quantities of containerships, RO/RO ships, LOTS equipment, mobile piers and their accessory equipment. |

Page
Reference

containers, chassis, tractors and interface equipment to provide prompt logistic support to contingency requirements. Full containerization from the first day is an integral part of this response. The capability should be sufficient to meet requirements for a minimum of 6 months until commercial contract augmentation can be obtained.

6-19 - 6-28

5. Using a two Division Strike Force with supporting troops or equivalent, as a module for analysis to determine container and support equipment mix, it has been determined that approximately 60,000 men could be deployed and supported for the 180 day period, with a full buildup by the end of 90 days, at a distance exceeding 7,000 miles with the following major items of equipment.
 - a. 10 selfsustaining containerships of 850 20' equivalent container capacity.
 - b. 6 RO/RO ships of the ADMIRAL WILLIAM M. CALLAGHAN type with 15,000 measurement ton cargo capacity.
 - c. 6 self-propelled lighters capable of carrying at least six containers each or equivalent, including barges and tugs.
 - d. 2 Beach Discharge Lighters similar to the LT. COL. JOHN U. D. PAGE.
 - e. 38,000 20' equivalent containers (30,000 8' high and 8,000 4' high).
 - f. 22,000 chassis.
 - g. 4 land-based mobile cranes capable of lifting loaded 20' containers.
 - h. 1 portable type pier (700' x 90') with reinforced decking.
 - i. 2 gantry cranes, and 2 roll-on/roll-off interface units.

Page
Reference

It is noteworthy that deployment is complete in 90 days over the shore. The portable type pier is required to simplify resupply operations.

Future Trends

1. The operation of large aircraft, as discussed earlier, will provide an airlift capability to augment or replace some of the sealift capability listed above. For example, a fleet of 40 C-5A aircraft making 5 round trips per month to Vietnam could lift approximately 40,000 to 50,000 measurement tons of containerized and RO/RO cargo per month. This amounts to about 20 percent of the total requirement and could reduce the total number of ships required by at least three and would, of course, eliminate the ship/shore interface for that element of cargo. However, an aircraft landing capability for that size aircraft must exist or be rapidly made available.
2. Future trends in the types of equipment required have been discussed above.

Policy Considerations

1. The DOD should own, control or have guaranteed access to sufficient vessels, containers and chassis to support contingency operations at a determined level until commercial augmentation can be obtained.
2. The DOD should own, and place in reserve stocks, sufficient mobile pier units, gantry cranes, mobile heavy lift equipment, and lighterage equipment to support contingency operations at a determined level. Such equipment should be maintained in a high state of readiness.

Page
Reference

3. Sea and airlift support capabilities should be analyzed to determine the optimum mix for contingency support.
4. If ownership by DOD of containerships, RO/RO ships, containers and chassis is elected, studies of the most effective peacetime use of these resources which will permit accomplishment of their contingency support mission should be made.

ANNEX A

**BASIC ELEMENTS OF INFORMATION FOR
CONTAINERIZATION MANAGEMENT**

ANNEX A
BASIC ELEMENTS OF INFORMATION
FOR CONTAINERIZATION MANAGEMENT

INTRODUCTION

Basic Elements of Information for the system evaluation of containers in the transportation mode were developed in connection with the planning for the Milvan Pilot Operation. The following list (extracted from APJ Report 589-2, "USAMC Milvan Pilot Operation Evaluation System", April 1969) is included as an example of the way in which information for container system management may be structured. These Basic Elements of Information were tested in mid-1969 and found feasible of manual implementation using existing reports and field observation.

COST ELEMENTS

- C-1 CONUS consignor costs - costs to ship and receive cargo, export/retrograde.
- C-2 Consolidation/distribution center costs - cost to receive, consolidate/breakbulk, and ship cargo, export/retrograde.
- C-3 CONUS linehaul costs - costs to ship cargo by highway and rail, export/retrograde.
- C-4 CONUS ocean and aerial terminal costs - costs to receive, handle and load containerized cargo, export/retrograde.
- C-5 Ocean shipping costs - cost to ship cargo by ocean mode, export/retrograde.
- C-6 Oversea Airlift costs - cost to ship cargo by air mode, export/retrograde.
- C-7 Oversea POD and APOD costs - costs to unload and handle containerized cargo, export/retrograde.
- C-8 Oversea drayage costs, POD or APOD to depot - costs to move containerized cargo between POD and depots located within POD complexes, export/retrograde.

COST ELEMENTS (cont'd)

- C-9 Oversea depot handling costs - cost to receive and/or ship containerized cargo.
- C-10 Oversea linehaul costs - costs to ship containerized cargo by highway and rail, export/retrograde.
- C-11 Oversea forward distribution point handling costs - costs to receive and/or ship containerized cargo.

TIME ELEMENTS

- T-1 CONUS consignor time - time to receive and/or ship a ton of containerized cargo.
- T-2 CONUS consolidation/distribution center time - time to receive, consolidate/breakbulk and ship a ton of containerized cargo.
- T-3 CONUS linehaul time - days from the time a shipment unit is offered to the T/O at origin until shipment arrives at POE, or APOE, or the CONUS retrograde cargo destination.
- T-4 CONUS ocean or aerial terminal time - days from receipt of the cargo until loaded aboard export or retrograde carrying vessel, aircraft or land vehicle, to include vessel/aircraft in-port time.
- T-5 Ocean or overseas airlift shipping time - time from the departure of vessel/aircraft until arrival at destination port, including time spent in holding areas enroute.
- T-6 Oversea ocean or aerial POD time - export time from arrival of vessel/aircraft until the departure of the average ton of cargo from the port, to include vessel/aircraft waiting time, delay time, and working time; retrograde time from receipt of cargo at the overseas ocean or aerial port until loaded aboard retrograde carrying vessel/aircraft, to include vessel/aircraft in-port time.

TIME ELEMENTS (cont'd)

- T-7 Oversea POD/APOD to depot time - linehaul time to move cargo between port and depot, export/retrograde.
- T-8 Oversea POD/APOD to forward distribution point (FDP) time - linehaul time to move cargo between port and FDP, export/retrograde.

PERFORMANCE ELEMENTS

- P-1 Export containerized cargo moved by IPG, by consignor, by consignee and by commodity group.
- P-2 Retrograde containerized cargo moved by IPG, by consignor, by consignee and by commodity group.
- P-3 Container volume utilization - export cargo in terms of MT per container, reduced to 20' equivalents.
- P-4 Retrograde use of containers - percent of returning containers which are empty.
- P-5 Weight limited shipments - use of containers for shipments on which the cubic content of the container is not filled to the normal 75 percent to 80 percent because of the density of the cargo and resultant weight limit for the movement of the containers.
- P-6 Loss-damage-pilferage - MT of cargo in containers which do not reach the consignee intact, as a percentage of total MT moved by containers.
- P-7 Turnaround time of containers consigned to oversea depots - time spent in oversea area in terms of a frequency distribution of the number of days from the time of arrival of the container at the POD/APOD to the departure back to CONUS of the same container from the POD/APOD.

PERFORMANCE ELEMENTS (cont'd.)

- P-8 Turnaround time of containers consigned to oversea forward distribution points - time spent in oversea area in terms of a frequency distribution of the number of days from the time of arrival of the container at the POD/APOD to the departure back for CONUS of the same container from the POD/APOD.
- P-9 Turnaround time of containers in CONUS - where applicable, time elapsing from retrograde arrival of a container at the CONUS POE/APOE until the export departure of that same container from CONUS POE/APOE, in terms of a frequency distribution of the number of days of that elapsed time.
- P-10 Total container turnaround time - presented in terms of a frequency distribution of the number of days of total turnaround time covering all nodes and legs.
- P-11 Container linehaul usage - actual usage of containers in the sense of the total distance traveled, in terms of number of container miles logged. To represent data from all nodes and legs with the exception of ocean or air shipments and to be further stratified by empty vs filled containers, export vs retrograde, and by CONUS vs oversea area.
- P-13 Empty military-owned container chassis on hand - measures the number of chassis not in use in the sense of not being attached to a container, in terms of average number of empty chassis on hand.
- P-14 Military-owned container NOR time - percent of total available container time containers were not operationally ready (NOR).
- P-17 Military-owned container equipment lost to system - measures the items of military-owned containers and chassis lost to the system.

PERFORMANCE ELEMENTS (cont'd.)

- P-18 Military-owned container geographic distribution - presents in terms of average number of containers on hand in a designated geographic area during each month and also a frequency distribution of the number of containers in each location to include CONUS, oversea areas and shipboard.
- P-19 Empty military-owned container time - measures the time during which military-owned containers are not in use for carrying or holding cargo.
- P-20 Loaded container time in stand-by - measures the time during which containers used for cargo movement were awaiting movement or unloading.
- P-21 Time to obtain containers - measures the average time required by shipper or consolidation/distribution center to obtain a container for which it has cargo, in terms of the average number of elapsed days from request for the container to its receipt.
- P-22 Container requests denied - presented in terms of the number of requests that are denied.
- P-23 Redispatched military-owned containers - presented in terms of the number of containers in a designated geographic area which were redispatched.
- P-24 Erroneous or missing military-owned container passing reports - presented in terms of the percent of passing reports which were erroneous or missing.

ENGINEERING ELEMENTS

- E-1 Identification and characteristics - the available facilities and services at all nodes for the handling of cargo in various configurations.

ENGINEERING ELEMENTS (cont'd)

- E-2 Availability and use of container loading facilities - the number of facilities available at all nodes for loading cargo into containers.
- E-3 Loading restrictions - physical limitations at all nodes restrict the loading of containers in terms of weight and dimensions of cargo which can be loaded.
- E-4 Working hours - for each node, information on normal, overtime, and Saturday and Sunday work.
- E-5 Methods of container stuffing - specific physical methods used at all nodes for container stuffing by commodity groups.
- E-6 Container maintenance facilities - maintenance facility capability in terms of equipment, personnel and availability of repair parts at depots and ocean terminals.
- E-7 Container chassis deficiencies - suitability of the container chassis for its mission and major failures and deficiencies. Information required in terms of failure frequency by subsystem and major sub-systems.
- E-8 Container deficiencies - requirements of E-7 related to the container.
- E-9 Container parts usage - quantities of repair parts required for both container and container chassis.
- E-10 Natural environment effects - effect of such environmental factors as rainfall, humidity, temperature, mud, salt, sand and dust.
- E-11 Application environments - the effects of peak acceleration loads on containers and on cargo in containers.

ANNEX B
BIBLIOGRAPHY

ANNEX B

BIBLIOGRAPHY

This Bibliography lists key references used in the analyses leading to this report. No attempt is made to list all the sources consulted. However, source material contributing directly to an understanding of military containerization in a contingency environment and to the findings and recommendations contained in the report are listed below.

Although not shown in the bibliography, a great deal of data and information were obtained from the Joint Logistics Review Board. Access to data and working papers, and the opportunity for extensive discussions with Board members assisted greatly in the conduct of the study.

BOOKS

Containerisation International 1970 Year Book, London, England, National Magazine Co., Ltd., 1969

Jane's Freight Containers 1969-70, London, England, Sampson Low, Marston & Company, Ltd., 1969

UNPUBLISHED ARTICLES

Schweitzer, Doug, Containerization (unpublished, Department of Civil Engineering, University of Saskatchewan Paper, January 1969)

Stevenson, Richard E., Major, TC, The Containerization Revolution - Its Military Impact, (unpublished U.S. Army Command and General Staff College research paper, 1968)

LETTERS AND MEMORANDUMS

Assistant Secretary of Defense (I&L) Letter, DOD Cost Reduction and Management and Improvement Program, 11 March 1969

Assistant Secretary of Defense (I&L) Letter, Inadequate Port Facilities and Off-Loading Delays, 14 January 1966

Assistant Secretary of Defense (I&L) Memoranda, Modification of Procedures for Transportation of Oversea Cargo, Army, Navy, Air Force and DSA, 18 June 1968, 15 October 1968, December 1968

Assistant Secretary of Defense (SA), Letter, Analysis of Containerships and Other Fast Turn-Around Shipping Systems for RVN Logistic Operations, 8 March 1966

Besson, Frank S., Jr., General, JLRB, Letter to Mr. Hardin U.S. Steel Corporation, 17 January 1967

Besson, Frank S., Jr., General, JLRB, Letter to President, Grace Lines, 17 November 1966

Department of Defense and Department of Commerce Memorandum of Agreement (re: Utilization, Transportation for and Allocation of Merchant Ships), 20 October 1954

Department of Defense and Department of Commerce Memorandum of Understanding (re: Civil Reserve Air Fleet), 8 August 1963

Director, Transportation and Warehousing Policy, Office, Secretary of Defense, Letter on Containerization, to General Frank S. Besson, JLRB

Murow, Arthur, Brigadier General, USA, Fact Sheet Attachment to Letter (re: LOTS operations in Vietnam) to Major General Heiser, 3 January 1969

J-4, JCS, Letter on Containerization (with questionnaire attachment) to CINCs of Unified and Specified Commands, 4 March 1969 with replies from: CINCPAC - 7 April 1969
CINCEUR - 10 September 1969
CINCSTRIKE - 7 August 1969

LETTERS AND MEMORANDUMS (Cont'd.)

MTMTS Letter, Containerized Military Cargo, to JLRB,
26 November 1969

MTMTS Letter, Through Bill/Through Container Service,
1 March 1966

U.S. Army Engineer Construction Agency, Vietnam
Memorandum, Planning Factors for Troop Construction,
31 August 1969

U.S. Army Materiel Command Letter, Test of Containerized
Shipments for Ammunition, (OPLAN TOCSA), 15 December 1969

U.S. Army Materiel Command, Letter to JLRB, Conex and
Packaging Information Request, (with Tabs A through H),
18 November 1969

DOD PUBLICATIONS

DOD Directive 3005.7, Emergency Requirements, Allocations,
Priorities and Permits for DOD Use of Domestic Civil Trans-
portation, 7 May 1968

DOD Directive 4500.9, Transportation and Traffic Management

DOD Instruction 4100.36, Cargo Unitization (I&L), 8 July
1964 (with C 1,2,3)

DOD Instruction 4410.6, Uniform Materiel Movement and Issue
Priority System (UMMIPS) (I&L), 24 August 1966 (with C 1)

DOD Instruction 5010.25, Logistics Performance Measurement
and Evaluation System-Procedures and Reporting Instructions
(I&L), 19 June 1969

DOD Instruction 7220.17, Cost Accounting for Central Supply
Management, Industrial Preparedness and Terminal Operations,
22 December 1966 (with C 2 and 3)

DOD Regulation 4500.32R, Military Standard Transportation
and Movements Procedures (MILSTAMP), 7 July 1966

DOD PUBLICATIONS (Cont'd.)

DSA Manual 7000.1, DSA Account Codes

DSA Report on Containerized Shipment for Overseas Perishable Subsistence Support, August 1969

Military Construction Status Report, RCS-DD-I&L(M) 915, 28 February 1969

DEPARTMENT OF ARMY PUBLICATIONS AND DOCUMENTS

AR 37-100-69, The Army Management Structure (Fiscal Code), 28 December 1967 (with C 1-4)

AR 55-355, Military Traffic Management Regulation (Joint), March, 1969

AR 740-6, Storage and Supply Activities, Depot Operations Cost and Performance Report, 9 January 1969

FM 5-35, Engineers Reference and Logistical Data, 23 February 1960

FM 55-15, Transportation Reference Data, 23 February 1968

FM 101-10-1, Staff Officers' Field Manual, Organization, Technical and Logistical Data, January, 1966

Headquarters, MTMTS, Annual Review of Transportation Trends, Fiscal Year 1969, September 1969

MTMTS 964 Report (RCS DD I&L(Q)), Logistics Performance Measurement and Evaluation System (Report for First Quarter Fiscal Year 1970)

MTMTS, Western Area, Container Traffic Reports, 1966-1968

U.S. Army Combat Development Command, Containerization of Supplies to an Infantry Battalion (Draft), April, 1969

U.S. Army Materiel Command Technical Report 69-19, Admiral Callaghan Cost and Performance Evaluation, James E. Rose, Jr. and Frank Quinn. June, 1969

JOINT CHIEFS OF STAFF PUBLICATIONS

Joint Chiefs of Staff, Publication 15, Mobility System Planning Compendium, 1 October 1968

Joint Chiefs of Staff, Special Assistant for Strategic Movement, SASM Statistical Reference Books, 1965-1966, 1967

Joint Chiefs of Staff, Special Assistant for Strategic Mobility, SASM Statistical Digest, 1968-1969

DEPARTMENT OF NAVY PUBLICATIONS AND DOCUMENTS

COMSTS Instruction 7600.30, Ship Per Diem Rates, 7 August 1967

MSTS Report 7700.2, Financial and Statistical Report

MSTS Merchant Ship Register, MSTS-P504, October, 1969

MSTS Report, RVN Sealift Digest, December 1968

Office, Chief of Naval Operations, Long Range Objectives Group, Sealift Requirements Study Progress Reports

U.S. Navy (MSTS) Report No. 3, Sealand Containership Service, U.S. Pacific Coast to Vietnam, 1969 (month unknown)

U.S. Navy, Vietnam Construction Report, September 1968

DEPARTMENT OF AIR FORCE PUBLICATIONS AND DOCUMENTS

Headquarters, U.S. Air Force, Air Logistics Studies-1970s, Annex A, Intransit Control, May 1967

Headquarters, U.S. Air Force, Containerization Study, 30 June 1969

U.S. Air Force Judge Advocate General Law Review, May-June 1968

U.S. Air Force Military Airlift Command, Air Fleet Allocation Summary, Monthly Civil Resume, (As of 30 September 1969)

OTHER GOVERNMENT AGENCY PUBLICATIONS

Federal Aviation Act of 1958, 49 U.S.C. 1302

Interstate Commerce Act, Parts I through V

Maritime Administration Containerships Under Construction and on Order, 30 June 1969

Maritime Administration, Division of Trade Studies, Report, 7 March 1969

Merchant Marine Act of 1936, U.S.C. 1101

Transportation Act of 1940, 54 Stat. 898

U.S. Department of Transportation Request for Proposal DOT-OS-A9-116, August 1969

BRIEFINGS

Army Materiel Command to JLRB, The Army Containerization Program, August 1969

Commander-in-Chief, Pacific Fleet to JLRB, Transportation Information, 20 September 1969

Department of the Air Force Briefing to NDTA Research and Education Council on General USAF Position, September 1968

Department of the Navy to JLRB, Containerization Briefing, 2 October 1969

Director, Transportation and Warehousing Policy, Office of the Secretary of Defense, to Materiel Secretaries, Impact of Containerization upon DOD Use of the Merchant Marine, 22 April 1969

Military Assistance Command, Vietnam, Expanded Container Service to RVN, March 1968

Military Sea Transport Service to JLRB, Presentation for the Joint Logistics Review Board, 19 June 1969

BRIEFINGS (Cont'd.)

Military Sea Transport Service to JLRB, Containerization Briefing, 31 July 1969

Military Traffic Management and Terminal Service to JLRB, The Vietnam Period, 10 June 1969

Military Traffic Management and Terminal Service to JLRB, Containerization, 3 September 1969

Naval Supply Depot, Subic Bay to JLRB, Untitled (Supply Topics) (Date unknown)

Naval Support Activity, Danang to the JLRB, Presentation to the Joint Logistics Review Board, 15 September 1969

Office, Chief of Naval Operations to JLRB, Integrated Sealift

U.S. Marine Corps to JLRB, Containerization Briefing, (date unknown)

OTHER PUBLICATIONS AND DOCUMENTS

Besson, General Frank S., Jr., Chairman, JLRB, Address to the Armed Forces Management Association, Washington, D. C., 4 March 1969

Castang, Viola, "What's in the Air for Aluminum Containers?" Air Transportation, February 1969

Chesarek, General F. J., Commanding General, U.S. Army Materiel Command, Address to 24th Annual Transportation and Logistics Forum, National Defense Transportation Association, Atlanta, Georgia, 23 September 1969

Department of Transportation Program - Task Force Organization, Defense Transportation, May-June 1968

Henry, James J. and Karsch, Henry J. Container Ships, The Society of Naval Architects and Marine Engineers, Publication No. 8, 24 October 1966

OTHER PUBLICATIONS AND DOCUMENTS (Cont'd.)

"Intermodal Development", Container News, October 1969

"Intermodal Pacesetter", Via Port of New York, July 1969

"ISO Approves 8'6" Height for 40-Foot Vans", Container News
January 1970

Lockheed-Georgia Company, C-5 Logistics Planning Manual,
Marietta, Georgia, August 1, 1968

National Academy of Sciences-National Research Council Report,
"A Study of Transportation of Hazardous Materials", May 1969

National Committee on International Trade, Press Release
(re Proposed new Shipping Form for U.S. Carriers and Shippers),
31 July 1969

"One Voice", (Editorial), Container News, January 1969

Regular Common Carriers' Conference, Containerization in
International and Domestic Commerce, Washington, D. C.
January 1968

Soules, Thomas, Present Development of Containers as Related
to the Port Administrator, (Paper presented to the Permanent
Technical Committee on Ports, at the 1st Inter-American Port
Seminar, Bogota, Colombia, March 1968

The Official Intermodal Equipment Register, Intermodal
Publishing Company, Ltd., May 1969

U.S. Air Force, USAF/AFLC Surface Container Study, Worldwide
Transportation Conference, 23-25 April 1969

AMERICAN POWER JET COMPANY REPORTS

APJ Report 121-7, Containerization Roll-On/Roll-Off, Summary
Report, May 1953

AMERICAN POWER JET COMPANY REPORTS (cont'd.)

APJ Report 121-8, Containerization Roll-on/Roll-off, Analysis of Rollvan, December 1953

APJ Report 128-4, Advanced Methods of Cargo Handling, September 1955

APJ Report 406-4, Methods for Evaluation and Selection of Unitization Candidates at NICPs, April 1965

APJ Report 406-8, Integrated Unitization for Army Operations-Project SUNSPOT Summary Report, August 1965

APJ Report 504-1, U.S. Army Cargo Containerization Requirements, Initial Report, October 1967

APJ Report 504-2, U.S. Army Cargo Containerization Requirements, Phase II, August 1968

APJ Report 504-301, U.S. Army Cargo Containerization Requirements, Engineering Analysis of Materials Handling and Transport Equipment Compatibility, August 1968

APJ Report 589-2, USAMC Milvan Pilot Operation Evaluation System, April 1969

APJ Reports 589-201 through 589-209, Containerization Engineering Evaluation, December 1968, Includes evaluations of vendors, CONUS and RVN Depots, CONUS and RVN Water Terminals, Marshalling and Shipside operations, CONUS Consolidation Points and RVN Forward Distribution Points

APJ Report 589-3, Milvan Pilot Operation Evaluation, Pre-Induction Phase, July 1969

APJ Report 589-4, USAMC Milvan Pilot Operation - Pre-Introduction Phase, Engineering Analysis, July 1969

ANNEX C
LIST OF ABBREVIATIONS
AND ACRONYMS

ANNEX C

LIST OF ABBREVIATIONS AND ACRONYMS

AAFES	Army Air Force Exchange Service
ADP	Automatic data processing
ADPE	Automatic data processing equipment
AFLC	Air Force Logistics Command
AID	Agency for International Development
Ammo	Ammunition
APJ	American Power Jet Company
APOD	Aerial port of debarkation
APOE	Aerial port of embarkation
ASL	Authorized stockage list
ATA	Air Transport Association
BARC	Barge, amphibious resupply, cargo
BEOI	Basic element of information
CAB	Civil Aeronautics Board
CINCPAC	Commander-in-Chief, Pacific
CINCPACFLT	Commander-in-Chief, Pacific Fleet
CINCSTRIKE	Commander-in-Chief, U.S. Strike Command
C/L	Carload
Commo	Communications
COMSTS	Commander, Military Sea Transport Service
Conex, Type I	Container, express - 4'3"x6'3"x6'10-1/2"(AF use)
Conex, Type II	Container, express - 8'6"x6'3"x6'10-1/2"(Army use)
CONUS	Continental United States (except Alaska)
COSCOM	Corps Support Command
CRAF	Civil Reserve Air Fleet
CRB	Cam Ranh Bay
CTAD	Container arrival date
CY	Calendar year

DA	Department of Army
DCSLOG	Deputy Chief of Staff, Logistics
DOD	Department of Defense
DOT	Department of Transportation
DSA	Defense Supply Agency
EO	Executive order
EAMTMTS	Eastern Area, Military Traffic Management and Terminal Service
FDP	Forward distribution point
FM	Field manual
FSN	Federal stock number
FY	Fiscal year
GAA	General agency agreement
GBL	Government Bill of Lading
GEM	Ground effect machine
GSA	General Services Administration
GTS	Gas turbine ship
HE	High explosive
IATA	International Air Transport Association
ICAF	Industrial College of the Armed Forces
ICP	Inventory control point
IPD	Issue priority designator
IPG	Issue priority group
ISO	International Standards Organization

JAG	Judge Advocate General
JCCA	Joint Conex Control Agency (now the Joint Container Control Agency)
JCS	Joint Chiefs of Staff
JLRB	Joint Logistics Review Board
LARC	Lighter, amphibious resupply, cargo
LASH	Lighter aboard ship
LCL	Less than carload
LCM	Landing craft, mechanized
LCO Lant	Logistic Control Officer, Atlantic
LCU	Landing craft, utility
LOTS	Logistics over the shore
LSD	Landing ship, dock
LST	Landing ship, tank
LTL	Less than truckload
MAC	Military Airlift Command
MACV	Military Assistance Command, Vietnam
MARAD	Maritime Administration
MHE	Materials handling equipment
MILSTAMP	Military Standard Transportation and Movement Procedure
MILSTRIP	Military Standard Requisitioning and Issue Procedure
Milvan	Military van, military intermodal container
MSTS	Military Sea Transport Service
MSTSPAC	Military Sea Transport Service, Pacific
MT	Measurement ton(s)
MTMTS	Military Traffic Management and Terminal

N/App	Not applicable
N/Av	Not available
NDRF	National Defense Reserve Fleet
NDTA	National Defense Transportation Association
NICP	National inventory control point
NOR	Not operationally ready
NVOCC	Non-vessel-owning common carrier
OASD (I&L)	Office, Assistant Secretary of Defense (Installations and Logistics)
OPLAN TOCSA	Operations Plan, Test of Containerized Shipments for Ammunition
OASD (SA)	Office, Assistant Secretary of Defense (Systems Analysis)
PACOM	Pacific Command
PLL	Prescribed load list
POD	Port of debarkation
POE	Port of embarkation
POL	Petroleum, oils and lubricants
PX	Post Exchange
RCS	Reports control symbol
RFP	Request for proposal
RO/RO	Roll-on/roll-off
RVN	Republic of Vietnam
SAE	Society of Automotive Engineers
SASM	Special Assistant for Strategic Movement
Seacon	Sea container
Seavan	Commercially owned intermodal container

SHEDS	Ship/Helicopter Extended Delivery System
SS	Steam ship
ST	Short ton (s)
STRATCOM	Strategic Communications Command
TAC	Tactical Air Command
TASTA 70	The Administrative Support Theater Army, 1970
TCMD	Transportation control and movement document
TCN	Transportation control number
TGBL	Through Government Bill of Lading
TICO	Through Intermodal Container Operation
T/L	Truck load
TMA	Traffic Management Agency
T/O	Transportation officer
TOE	Table of Organization and Equipment
UK	United Kingdom
UMMIPS	Uniform Materiel Movement and Issue Priority System
USACDC	United States Army Combat Development Command
USAF	United States Air Force
USAMC	United States Army Materiel Command
USAREUR	United States Army, Europe
USARPAC	United States Army, Pacific
USASI	United States of America Standards Institute
USCINCEUR	United States Commander-in-Chief, Europe
USEUCOM	United States European Command
USMC	United States Marine Corps
USNS	United States Navy Ship
USS	United States Ship

WAMTMS	Western Area, Military Traffic Management and Terminal Service
WASP	War Air Service Program

APPENDIX B

LIST OF ACRONYMS AND ABBREVIATIONS

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LIST OF ACRONYMS AND ABBREVIATIONS

AAFES	Army and Air Force Exchange Service
AB & T	Alaska Barge and Transport Company
A/C	aircraft
ACL	Atlantic Container Line Ltd
Adm	administration
ADP	automatic data processing
ADPE	automatic data processing equipment
AFLC	Air Force Logistical Command
AID	Agency for International Development
Ammo	ammunition
ANSI, ASI	American National Standards Institute
APOD	aerial port of debarkation
APOE	aerial port of embarkation
APJ	American Power Jet Company
ASL	authorized stockage list
ASD	Assistant Secretary of Defense
ATA	Air Transport Association
BARC	barge, amphibious resupply cargo
BDL	barge, discharge lighter
BEOI	basic element of information
CAB	Civil Aeronautics Board
CINCPAC	Commander in Chief, Pacific
CINCPACFLT	Commander in Chief, Pacific Fleet
CINCSTRIKE	Commander in Chief, U. S. Strike Command

CONTAINERIZATION

C/L	car load
COFC	container on flat car
commo	communications
COMSTS	Commander, Military Sea Transport Service
CONEX	container, express
const mtl's	construction materials
constr	construction
CONUS	continental United States
COSCOM	Corps Support Command
CRAF	Civil Reserve Air Fleet
CRB	Cam Rahn Bay
CTAD	container arrival date at terminal
CY	calendar year
DCSLOG, DA	Deputy Chief of Staff for Logistics, Department of the Army
DOD	Department of Defense
DOT	U. S. Department of Transportation
DSA	Defense Supply Agency
EAMTMTS	Eastern Area, Military Traffic Management and Terminal Service
E. O.	Executive Order
FDP	forward distribution point
FM	field manual
FSN	federal stock number
FY	fiscal year
FYDP	Five Year Defense Program
GAA	General Agency Agreement
GBL	Government Bill of Lading
GEM	ground effect machine
GSA	General Services Administration

CONTAINERIZATION

GTS	gas turbine ship
HE	high explosive
IATA	International Air Transport Association
ICAF	Industrial College of the Armed Forces
ICP	inventory control point
IPD	issue priority designator
IPG	issue priority group
ISO	International Standards Organization
JAG	Judge Advocate General
JCCA	Joint Container Control Agency
JCS	Joint Chiefs of Staff
JLRB	Joint Logistics Review Board
LARC	lighter, amphibious resupply, cargo
LASH	lighter aboard ship
LCL	less than car load
LCO Lant	Logistic Control Officer, Atlantic
LOGPLAN	Logistic Plan
LOTS	logistics-over-the-shore
LTL	less than truck load
MAC	Military Airlift Command
MACV	Military Assistance Command, Vietnam
MARAD	Maritime Administration
MHE	materials handling equipment
MIDA	Major Items Data Agency
MILSTAMP	Military Standard Transportation and Movement Procedures
MILSTRIP	Military Standard Requisitioning and Issue Procedures
MILVAN	military van (intermodal container)
MOVECAP	movement capability

CONTAINERIZATION

MOWASP	Mechanization of Warehousing and Shipping Procedure
MPS	multipurpose ships
MSTS	Military Sea Transportation Service
MSTSLANT	Military Sea Transportation Service, Atlantic
MSTSPAC	Military Sea Transportation Service, Pacific
MTMTS	Military Traffic Management and Terminal Service
MTONS, MT, M/T	measurement tons
N/ App	not applicable
NATO	North Atlantic Treaty Organization
N/ Av	not available
NDRF	National Defense Reserve Fleet
NDTA	National Defense Transportation Association
NICP	National Inventory Control Point
NOR	not operationally ready
NSA	Naval Support Activity
NVOCC	non-vessel-owning common carrier
OSD	Office of the Secretary of Defense
OASD (I&L)	Office of the Assistant Secretary of Defense (Installations and Logistics)
OPLAN TOCSA	Operation Plan Test Containerized Shipment of Ammunition
OSD (SA)	Office of the Secretary of Defense (Systems Analysis)
PACOM	Pacific Command
PLL	prescribed load list
POD	Port of Debarkation
POE	Port of Embarkation
POL	petroleum, oils and lubricants
PX	Post Exchange
RC'S	report control

CONTAINERIZATION

RFP	request for proposal
Ro/ Ro	Roll-on/ Roll-off
RVN	Republic of Vietnam
SAAM	Special Assignment Airlift Mission
SAE	Society of Automotive Engineers
SASM	Special Assistant for Strategic Mobility
SEABEE	Sea Barge Carriers
Seacon	Sea container
Seavan	Sea van (commercial intermodal container)
SE Asia	Southeast Asia
SHEDS	Ship Helicopter Extended Delivery
SS	steam ship
STON, ST	short tons
STRATCOM	Strategic Communications Command
TAC	Tactical Air Command
TASTA 70	The Administrative Support Theatre Army '70
TCMD	Transportation Control and Movement Document
TCN	transportation control number
TGBL	through Government bill of lading
TICO	Through Intermodal Container Operations
T/ L	Truck Load
TMA	Transportation Management Agency
T/O	Transportation Officer
TOCSA	Test of Containerized Shipment of Ammunition
TOE	Table of Organization and Equipment
TOFC	Trailer on flat car
UK	United Kingdom
UMMIPS	Uniform Materiel Movement and Issue Priority System
USA	United States Army

CONTAINERIZATION

USACDC	United States Army Combat Developments Command
USAMC	United States Army Materiel Command
USAF	United States Air Force
USAREUR	United States Army, Europe
USARV	United States Army, Vietnam
USASI	United States of America Standards Institute
USCINCEUR	U. S. Commander in Chief, Europe
USCINCPAC	U. S. Commander in Chief, Pacific
USEUCOM	U. S. European Command
USMC	United States Marine Corps
USNS	U. S. Navy Ship
USS	U. S. Ship
WAMTMTS	Western Area, Military Traffic Management and Terminal Service
WASP	War Air Service Program
WRSK	War Readiness Spare Kits

APPENDIX C
BIBLIOGRAPHY

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UNPUBLISHED THESIS

Stephenson, Richard E., Major, Transportation Corp, The Containerization Revolution — Its Military Impact, unpublished research paper, U.S. Army Command and General Staff College, April 1968.

DEPARTMENT OF DEFENSE PUBLICATIONS

- Secretary of Defense (Systems Analysis), Military Container Operations, 10 December 1969.
- Joint Chiefs of Staff, JCS Publication 15, Mobility System Planning Compendium, 1 October 1968.
- Joint Chiefs of Staff, Special Assistant for Strategic Mobility, MOVECAP Corollary Study: Use of Containers in Military Operations, 16 December 1968.
- Department of Defense, Status Report, Logistics Performance Measurement and Evaluation System, 30 September 1969.
- Department of Defense, Status Report, Logistics Performance Measurement and Evaluation Systems, 31 December 1969.
- Department of Defense, Military Construction Status Report, RCS DD-I&L (M) 915, 28 February 1969.
- Department of Defense, DOD Directive 4500.9, Transportation and Traffic Management, 27 September 1968.
- Department of Defense, DOD Directive 5010.24, Logistics Performance Measurement and Evaluation System, 29 May 1969.
- Department of Defense, DOD Directive 5126.43, DOD Logistics System Planning, 26 March 1970.
- Department of Defense, DOD Directive 5160.2, Single Manager Assignment for Airlift Service, 24 March 1967.
- Department of Defense, DOD Directive 5160.10, Single Manager Assignment for Ocean Transportation, 24 March 1967.
- Department of Defense, DOD Directive 5160.53, Single Manager Assignment for Military Traffic, Land Transportation, and Common-User Ocean Terminals, 24 March 1967.
- Department of Defense, DOD Instruction 4100.36, Cargo Unitization (I&L) (with C 1, 2, 3), 8 July 1964.
- Department of Defense, DOD Instruction 4410.6, Uniform Materiel Movement and Issue Priority System (UMMIPS) (I&L), (with C 1), 24 August 1966.
- Department of Defense, DOD Instruction 5010:25, Logistics Performance Measurement and Evaluation System- Procedures and Reporting Instructions (I&L), 19 June 1969.
- Department of Defense, DOD Instruction 7220.17, Cost Accounting for Central Supply Management, Industrial Preparedness and Terminal Operations (with C 2, 3), 22 December 1966.

CONTAINERIZATION

- Department of Defense, DOD Regulation 4500.32R, Military Standard Transportation and Movements Procedures (MILSTAMP), 7 July 1966.
- Department of Defense, Defense Supply Agency Report, Containerized Shipment for Overseas Perishable Subsistence Support, August 1969.
- Department of Defense, DOD Joint Regulation, AR 55-167, AFR 75-49, OPNAVINST 4610.5A, Transportation and Travel Policy Governing Transportation of Cargo by Military Sea Transportation Service, 27 November 1957.
- Department of Defense, DOD Joint Regulation, AR 55-165, AFR 75-5, Transportation and Travel — Agreement Between Army and Air Force for Joint Operation of Cargo Transporter in CONEX Service, 12 October 1956.
- Department of Defense, DOD Joint Regulation, AR 55-17, AFR 75-36, Transportation and Travel Lease of CONEX Transporters, 19 March 1963.
- Department of the Army, U.S. Army Materiel Command, Operation Plan, Test of Containerized Shipment of Ammunition (OPLAN TOCSA) 12 December 1969.
- Department of the Army, 1st Logistical Command, After Action Report, Project TOCSA, Test of Containerized Shipments for Ammunition, 17-21 January 1970.
- Department of the Army, Military Traffic Management and Terminal Service, MTMTS Pamphlet 55-2, Transportation and Travel — Guidelines for Stuffing Containers, 1 August 1968.
- Department of the Army, Army Materiel Command Regulation 1-12, Policy #55.4, Transportation and Travel — Containerization.
- Department of the Army, Army Regulation 55-175, Transportation and Travel — Cargo Transporter Report, 3 September 1958.
- Department of the Army, Army Regulation 55-166, Transportation and Travel — Utilization of Cargo Transporter in CONEX Services, 27 June 1957.
- Department of the Army, Army Concept for Use of C5/Heavy Lift Aircraft in the Combat Service Support Role, Policy Statement, 13 January 1970.
- Department of the Army, Military Traffic Management and Terminal Service Pamphlet, MTMTS — Four Years of Progress, 27 January 1969.
- Department of the Army, Military Traffic Management and Terminal Service Pamphlet, Chronology of MTMTS, 24 February 1969.
- Department of the Navy, Chief of Naval Operations Study, Integrated Sealift Study, Alternative Sealift Program for Mobility Forces MPMU (U), 1 October 1969 (SECRET)
- Department of the Navy, Naval Ammunition Depot, Bangor, Study, Containerization of Ordnance for Naval Outloading, 29 August 1969.
- Department of the Navy, Naval Ammunition Depot, Earle, Study, Containerization of Ordnance for Outloading, 28 August 1969.
- Department of the Navy, Naval Weapons Station, Concord, Study, Containerization of Ordnance for Outloading, 9 September 1969.
- Department of the Navy, Commander Service Forces Pacific Fleet, Weekly Summary, Command History, 3 December — 9 December 1967.
- Department of the Air Force, Headquarters, U.S. Air Force, Air Logistics Studies — 1970's, Annex A, Intransit Control, May 1967.
- Department of the Air Force, Military Airlift Command, MAC Manual, MM 76-1, Military Airlift Transportation Manual, 16 June 1969.

CONTAINERIZATION

Department of the Air Force, Military Airlift Command, MAC Pamphlet, The Development of Strategic Airlift for Armed Forces of U.S., July 1968.

Department of the Air Force Judge Advocate General Law Review, June 1968.

DOD LETTERS, MEMORANDUMS, AND MESSAGES

Secretary of Defense (Systems Analysis), Letter, subject: Analysis of Containerships and Other Fast Turn-around Shipping Systems for RVN Logistic Operations, 8 March 1966.

Office of the Secretary of Defense, Director, Transportation and Warehousing Policy, Letter to General Besson, JLRB, subject: Containerization, 13 March 1969.

Assistant Secretary of Defense (Installations and Logistics), Letter, subject: Inadequate Port Facilities and Off-Loading Delays, 14 January 1966.

Assistant Secretary of Defense (Installations and Logistics), Letter, subject: DOD Cost Reduction and Management and Improvement Program, 11 March 1969.

Assistant Secretary of Defense, Memorandum, subject: Through Government Bill of Lading (TGBL) Transportation, 10 July 1965.

Assistant Secretary of Defense, Memorandum, subject: Establishment of the Program Coordinator for Containerized Shipments, 23 October 1967.

Assistant Secretary of Defense (Installations and Logistics), Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 18 June 1968.

Assistant Secretary of Defense, Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 15 October 1968.

Assistant Secretary of Defense (Installations and Logistics), Memorandum, subject: Modification of Procedures for Transport of Overseas Cargo, 23 January 1969.

Assistant Secretary of Defense (Installations and Logistics), Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 13 May 1969.

Assistant Secretary of Defense, Memorandum, subject: Procurement of Ocean Transportation for Overseas Containerized Cargo, 14 January 1970.

Assistant Secretary of Defense, Memorandum, subject: Procurement of Ocean Transportation for Overseas Containerized Cargo, 2 February 1970.

Department of Defense and Department of Commerce, subject: Memorandum of Understanding, (re Civil Reserve Air Fleet), 8 August 1963.

Assistant Secretary of the Army (Installations and Logistics), Memorandum, subject: Proposed Program Coordinator for Containerized Shipments, 20 March 1968.

Assistant Secretary of the Army, Memorandum, subject: Overseas Movement of Containerized Cargo, 30 December 1969.

Assistant Secretary of the Army, Memorandum, subject: Procurement of Ocean Transportation for Overseas Containerized Cargo, 19 February 1970.

Assistant Secretary of the Army, Memorandum, for Deputy Chief of Staff for Logistics, subject: Report of-the-Test of Containerized Shipments of Ammunition (Project TOCSA), 12 May 1970.

Assistant Secretary of the Navy, Installations and Logistics, Memorandum, subject: Establishment of a Program Coordinator for Containerized Shipment, 7 December 1967.

Under Secretary of the Navy, Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 19 August 1968.

CONTAINERIZATION

- Under Secretary of the Navy, Memorandum, subject: Implementation of Assistant Secretary of Defense (Installations and Logistics) Memo of 18 January 1968, subject: Modification of Procedures for Transportation of Overseas Cargo, 10 October 1968.
- Under Secretary of the Navy, Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 13 January 1969.
- Under Secretary of the Navy, Memorandum, subject: Modification of Procedures for Transportation of Overseas Cargo, 4 June 1969.
- Under Secretary of the Navy, Memorandum, subject: Conflicting Methods for Procurement of Intermodal Shipment Overseas i. e., MSTs Container Agreement-TGBL Tenders, 24 December 1969.
- Under Secretary of the Navy, Memorandum, subject: Procurement of Ocean Transportation for Overseas Containerized Cargo, 20 February 1970.
- Under Secretary of the Navy, Memorandum, subject: Procurement of Ocean Transportation for Overseas Containerized Cargo, 6 March 1970.
- Under Secretary of the Navy, Memorandum, subject: Procurement of Through Movement Service for Overseas Cargo, 6 March 1970.
- Assistant Secretary of the Air Force (Installation and Logistics), Memorandum, subject: Establishment of a Program Coordinator for Containerized Shipments, 21 November 1967.
- Joint Chiefs of Staff, Memorandum, for the Assistant Secretary of Defense (Legislative Affairs), MJCS-365-69, subject: Information for the Special Sub-Committee on Sea Power (Military Use of Containerships) 24 July 1969.
- Joint Chiefs of Staff, Memorandum, for the Assistant Secretary of Defense JCSM-121-68, subject: Establishment of the Program Coordination for Containerized Shipments, 28 February 1968.
- Joint Chiefs of Staff, Memorandum, for Chief of Staff, U.S. Army and Chief of Naval Operations, SM-553-68, subject: Through Intermodal Containers Operations, 10 August 1968.
- Joint Chiefs of Staff, Special Assistant for Strategic Mobility, Memorandum, for Joint Staff, SASM 28-68 subject: Establishment of the Program Coordinator for Containerized Shipment. 16 January 1968.
- Joint Chiefs of Staff, Special Assistant for Strategic Mobility, Internal Memorandum, subject: The Role of Special Assistant for Strategic Mobility in the Unitization/Containerization Program, 20 September 1968.
- Joint Chiefs of Staff, Memorandum, for Assistant Secretary of Defense Installations and Logistics, MJCS-513-67, subject: Establishment of the Program Coordinator for Containerization Shipments, 15 November 1967.
- Ensey, Lot, Vice Admiral, Joint Chiefs of Staff, J-4, Letter, subject: Containerization (with questionnaire attachment) to all CINCs of Unified and Specified Commands, 4 March 1969.
- Commander in Chief, Atlantic, reply, dated 23 April 1969, to Vice Admiral Ensey, JCS, J-4, subject: Letter on Containerization, 4 March 1969.
- Commander in Chief, Continental Air Defense Command, Reply to Vice Admiral Ensey, JCS, J-4, 4 March 1969, subject: Letter on Containerization, 9 May 1969.
- Commander in Chief, Europe, reply, dated 10 September 1969, to Vice Admiral Ensey, JCS J-4, subject: Letter on Containerization, 4 March 1969.
- Commander in Chief, Pacific, Memorandum, for Chairman, JLRB Office of the Secretary of Defense, subject: Forwarding of Additional Data, 7 March 1970.
- Commander in Chief, Pacific, reply, dated 7 April 1969, to Vice Admiral Ensey, JCS, J-4, subject: Letter on Containerization, 4 March 1969.

CONTAINERIZATION

- Commander in Chief, Southern Command, reply, dated 28 April 1969, to Vice Admiral Ensey, JCS, J-4, subject: Letter on Containerization, 4 March 1969.
- Commander in Chief, U.S. Strike Command, reply, dated 7 August 1969, to Vice Admiral Ensey, JCS, J-4, subject: Letter on Containerization, 4 March 1969.
- Joint Logistics Review Board, Message 201300Z November 1969 to Commander in Chief, Pacific, subject: Test of Off Shore Discharge Selfsustaining Containerships.
- Department of the Army, 1st Logistical Command, Message 310918Z January 1970, to Army Materiel Command, subject: Containerization Ammunition Shipment.
- Department of the Army, Letter, to JLRB, subject: U.S. Army Containerization Policy, 25 February 1970.
- Department of the Army, U.S. Army Materiel Command, Letter, subject: Report of Project TOCSA (Test of Containerization Shipments of Ammunition), 20 April 1970.
- Department of the Army, Headquarters, U.S. Army Materiel Command, Letter, to JLRB, subject: CONEX and Packaging Information Request, 18 November 1969.
- Department of the Navy, Military Sea Transportation Service, Letter, subject: Container Booking Procedures, 8 September 1969.
- Department of the Navy, Military Sea Transportation Service, Memorandum, for the Under Secretary of the Navy, subject: Implementation of ASD (I&L) Memo of 18 June 1968, subject: Modification of Procedures for Transportation of Overseas Cargo, 10 October 1968.
- Department of the Navy, Military Sea Transportation Service, Memorandum, subject: ASD (I&L) Memo of 15 October 1968, subject Modification of procedures for Transportation of Overseas Cargo, 23 October 1968.
- Department of the Navy, Military Sea Transportation Service, Memorandum, for Chairman JLRB, Office of the Secretary of Defense, subject: Roll-on/Roll-off Operations, 25 November 1969.
- Chief of Naval Operations, Memorandum, for Senior Navy Member, JLRB, Serial Number 001132P404, subject: MSTS Ship Replacement Program, 22 October 1969.
- Senior Marine Corps Representative, JLRB, to Coordinator, Task Force "Echo" JLRB, subject: Cargo Movement, 16 December 1969.
- Air Force Director of Transportation, Memorandum, to Air Force Deputy Chief of Staff, Systems and Logistics, subject: Containerization (Your Memo, 10 April 1970), Proposed article attached.

BRIEFINGS, PRESENTATIONS, AND CONFERENCE MINUTES

- Department of Defense, Minutes of the Meeting of the Logistics Systems Policy Council, 14 March 1970.
- Office of the Secretary of Defense, Director, Transportation and Warehousing Policy, Briefing to Materiel Secretaries, subject: Impact of Containerization Upon DOD Use of the Merchant Marine, 22 April 1969.
- Commander in Chief, Pacific Fleet, Briefing, subject: Transportation Information, 20 September 1969.
- STRIKE Command, Briefing, to JLRB, subject: Containerization.
- Department of the Army, Briefing, subject: Containerization, 21 July 1969.
- Department of the Army, Briefing, to JLRB, subject: Transportation Movement Control, Ports and Terminals and Containerization, 19 August 1969.

CONTAINERIZATION

- Department of the Army, Military Traffic Management and Terminal Service, subject: The Vietnam Period, 10 June 1969.
- Department of the Army, Military Traffic Management and Terminal Service, Briefing, subject: Containerization, 31 July 1969.
- Department of the Army, U.S. Army Materiel Command, Chief, Containerization Branch, Transportation Division, Directorate of Distribution and Transportation, Briefing, subject: The Army Containerization Program, August 1969.
- Department of Army, U.S. Army, U.S. Army Materiel Command, Packaging and Storage Center, Tobyhanna Army Depot, Briefing, subject: Packaging for Southeast Asia 1965 to Present, 17 October 1969.
- Department of Army, U.S. Army Transportation Engineering Agency, Briefing, to MTMTS, subject: Consolidation of Containerizable Cargo, 9 June 1969.
- Department of the Navy, Briefing to the JLRB, subject: Containership, 2 October 1969.
- Department of the Navy, Military Sea Transportation Service, subject: Presentation for the JLRB, 19 June 1969
- Department of the Navy, Military Sea Transportation Service, Presentation to the JLRB, subject: Containership, 31 July 1969.
- Department of the Navy, Military Sea Transportation Service, Pacific, Briefing to JLRB, subject: Container Operation in the Pacific, 5 March 1969.
- Department of the Navy, Military Sea Transportation Service, Pacific, subject: Containership Presentation to the JLRB, 3 September 1969.
- Department of the Navy, Commander, U.S. Naval Support Activity, Presentation to the JLRB, 15 September 1969.
- U.S. Marine Corps, Containerization Briefing to the JLRB.
- Department of the Air Force, Briefing to NDTA Research and Education Council, subject: General USAF Position, September 1968.
- Mattingly, Joseph G., Jr, Lt. Colonel, U.S. Army, Speech to National Security Industrial Association, Joint Technical Coordinating Group for Containerization, Joint Logistical Commanders, 17 September 1969.

MISCELLANEOUS PUBLICATIONS AND DOCUMENTS

- American Power Jet Company Report 504-1, U.S. Army Cargo Containerization Requirements, Initial Report, October 1967.
- American Power Jet Company Report 504-2, U.S. Army Cargo Containerization Requirements, Phase II, August 1968.
- American Power Jet Company Report 504-301, U.S. Army Cargo Containerization Requirements, August 1968.
- American Power Jet Company Report 589-2, USAMC Milvan Pilot Operation Evaluation System, April 1969.
- American Power Jet Company Report 589-3, Milvan Pilot Operation Evaluation, Preinduction Phase, July 1969.
- American Power Jet Company Report 589-4, USAMC Milvan Pilot Operation — Preinduction Phase, Engineering Analysis, July 1969.
- Business Week, "Roll-on Ships Gather More Cargo," 10 May 1969, pp. 74-76.
- Case, Frank B., Colonel, U.S. Army, Army Logistician, Volume 2, Number 2, "Continuities, Container Ships, and Lighterage," March-April 1970, pp. 16-22.

CONTAINERIZATION

- Casey, Maurice F., Brigadier General, U.S. Air Force, "USAF Modernizes Total Air Transport System," Armed Forces Management, Volume 15, Number 2, December 1968, pp. 55-57.
- Casey, Maurice F., Brigadier General, U.S. Air Force, "Outlook for Air Force Materials Handling and Packaging," Defense Transportation, Volume 26, Number 1, January-February 1970, pp. 35-39.
- Casting, Viola, "What's in the Air for Aluminum Containers?" Air Transportation Magazine, February 1969.
- Chief Western Pacific Transportation Office (CINCPAC J-45), Memorandum, subject: Interest Item-Containerized Shipments (Project Ammo-Van), 27 January 1970.
- Container News Magazine, Editorial (on Proposed Joining of Three Leading U.S. Maritime Organizations), January 1969.
- Container News Magazine, "ISO Approves 8'6" Height for 40-foot Vans," January 1970.
- Defense Transportation, "Annual Containerization Issue," May-June 1970.
- Equity Research Associates, Containerization, New York, New York, 16 May 1969.
- Interstate Commerce Commission, Letter, to Chairman, subject: Committee on Commerce, U.S. Senate, 1 April 1969.
- Keddington, Neil H., Major, U.S. Air Force, "Military Combines for New Airlift Era," Air Cargo, July 1969.
- Arthur D. Little, Inc., Phase I Report to American Merchant Marine Institute, Inc., "Standards for Cargo Containers," July 1967, p. 17.
- Lockheed Industrial Products, Air Freight Van Size Container Through 1975: A Study of Parameters, May 1968.
- McCullough, John T., "Containerization, Comes of Age," Distribution Manager, October 1968.
- MSTS Contract with Sealand Service, No. 00337SA1029, 29 March 1967.
- Northern, Michael B., "Carrier Reports 92% Drop in Claims," Container News, 18 November 1969.
- Notes and Comments, Container News Magazine, October 1969.
- Official Proceedings, DOD Containerization Usage Briefing for NDTA, 23 September 1968.
- Planning Research Corporation Report, PRCR - 1036, Development of Logistical Planning Factors in South Vietnam, 23 September 1967.
- Railway Age, "You ought to Know," 16 December 1968.
- Redling, W.N., Colonel, U.S. Army, Industrial College of Armed Forces, Term Paper, Cargo Handling Methods - Containerization, 3 May 1955.
- Regular Common Carriers' Conference, American Trucking Associates, Inc., Regular Common Carriers' Report on Containerization in International and Domestic Commerce.
- Rhoads, W.R., "Packaging for the New Dimensions in Air Lift," Defense Transportation, Volume 26, Number 1, January-February 1970, pp. 54-57.
- Traffic World, 30 March 1968.
- Via Port of New York Magazine, "Intermodal Pacesetter," July 1969.